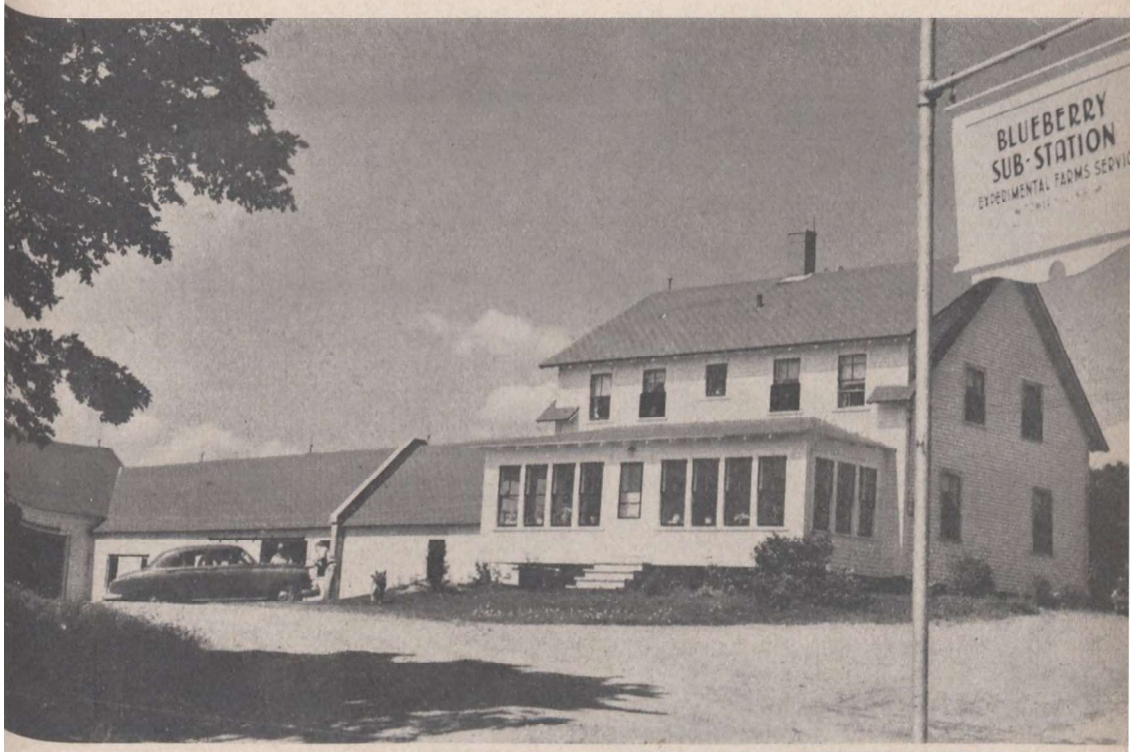
CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS AND SCIENCE SERVICES

# DOMINION BLUEBERRY SUBSTATION

# TOWER HILL, N.B.

Prepared by Members of
Research and Advisory Committees

## PROGRESS REPORT
## 1949-1953




ENTRANCE TO BLUEBERRY SUBSTATION
TOWER HILL, NEW BRUNSWICK

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## DOMINION BLUEBERRY SUBSTATION
## TOWER HILL, N.B.

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Officer-in-Charge—R. G. White
Acting Foreman—Bruce Scott

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| | |
|---|---|
| W. Hyslop | R.R. No. 2, Moore's Mills, Charlotte Co., N.B. |
| R. Hawkins | Pennfield, Charlotte Co., N.B. |



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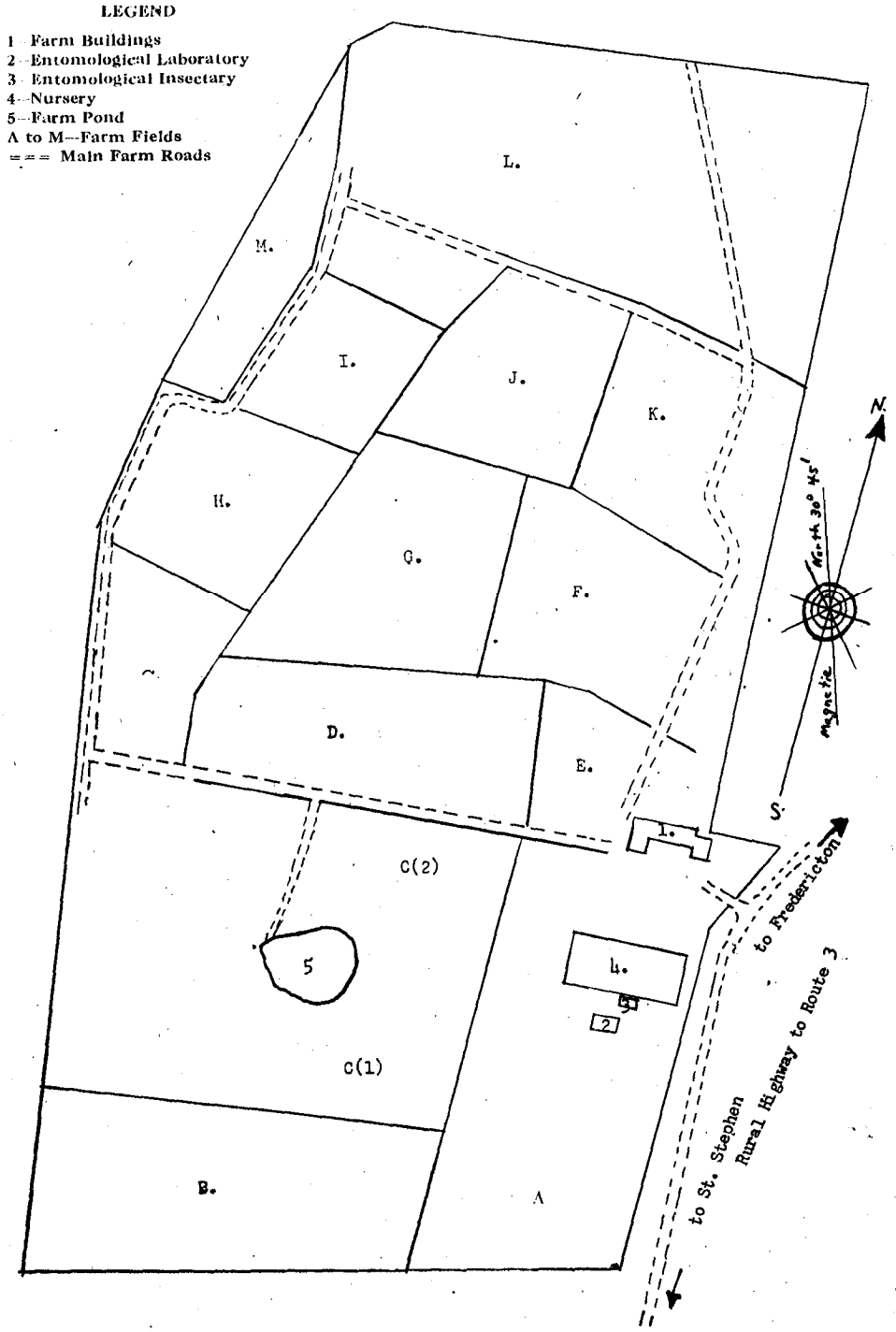
# BLUEBERRY SUBSTATION, TOWER HILL, N.B.



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## INTRODUCTION

The Tower Hill Blueberry Substation was established at Central Tower Hill, Charlotte county, N.B., in 1949 to investigate problems peculiar to the culture of the lowbush blueberry. It is located in an area largely devoted to this native crop and is designed not only to serve the growers in Charlotte county, but all other areas in the Maritime Provinces where blueberries are grown commercially. The property consists of 50 acres of blueberry land, together with a residence and suitable buildings.

Directing the work is a six-man research committee composed of research officers from the Botany and Plant Pathology Division, Science Service, Kentville; the Entomology Division, Science Service, Fredericton; the New Brunswick Department of Agriculture; and the Experimental Stations at Kentville, Charlottetown, and Fredericton. An advisory board to this research committee is made up of growers and other research officers and meets on call to discuss general problems related to blueberry culture. Administration is centred at the Experimental Station, Fredericton, N.B.

The period under review covers the initial phases in establishing the new Substation. Lights, water, sewerage, and a heating system were installed, the foundations of the buildings checked, roofs re-shingled, wood surfaces painted, the fields cleaned up, a farm pond constructed for irrigation and fire protection, and a barn converted into two rooms, one for a laboratory the other for general storage. Equipment purchased included a half-ton truck, a tractor, a pumper and hose for fire protection, necessary farm machinery and small tools.

Making a soil survey and a farm plan were among the first undertakings. The Fruit Insect Section of the Science Service, Fredericton, has moved its local Field Laboratory and staff to the Substation. The Plant Pathology Laboratory, Science Service, Kentville, has its own research officers conducting projects at and from the Substation. Close liasion has thus been established between the Experimental Farms Service and Science Service, and with the various units of the provincial Department of Agriculture.

This report covers the period 1949 to 1953, inclusive, and presents the findings of the various participating units. Appreciation is expressed for the co-operation that has prevailed between the Research Committee and the Advisory Board.

## HORTICULTURE

*E. L. Eaton*

There are three broad phases of the horticultural studies: improvement of existing stands; planting of new fields; and selection and multiplication of better varieties for planting. Present commercial production is almost entirely from fields where the blueberry has established itself naturally.

The blueberry normally occupies an intermediate place in the succession of plants between field and forest. The dense network of underground stems serves a useful purpose in binding together open soils while the trash that gathers above ground soon forms a seedbed for various shrubs, hardwoods, and conifers. Thus, stands of blueberries are seldom pure and human efforts are aimed toward keeping conditions as favorable as possible for the blueberries and as unfavorable as possible for other plants.

### Brush Cutting

The time-honoured method of removing unwanted plants is to cut them down. Late fall and winter usually offer more leisure and work of this sort is more often done in the cool part of the year. Conifers are easily killed but birch, maple, witherod, cherry, willow and others sprout again freely if cut during fall, winter or spring.

Field J, on the Substation, has been used since 1949 for a comparison of different cutting dates. Six strips, each 55 feet wide, were marked off, and one strip cut each month from May to October. The treatments were repeated annually on the same area. Differences were apparent after the first year and have been greater as each year passed. Cutting in May, June and October did not retard brush growth to any extent. September cutting retarded brush slightly while July and August were about equal and brush killing then was far superior to any of the others. Sprouts cut at this time were in full leaf and had the added advantage of providing more trash to carry the fire the next spring. In 1951 in Field C2, yields of blueberries were not reduced by cutting brush among them in midsummer. A detailed study of the plant population on these plots is given on page 21.

### Chemical Weed Killers

**Summer Sprays**

With the large number of chemical weed killers on the market, it seemed desirable to learn whether any could be used with safety among blueberries. Field I, contained a vigorous stand of the common woody perennials, the birch and maple being 4 to 6 feet tall. A thin stand of blueberries existed, largely the species known locally as sour top, *(Vaccinium myrtilloides* Michx). In 1949 the field was divided in half, one portion having the materials applied in June, the other having the brush cut in June and applications made in August to the new sprouts.

The materials used included Herbate, Esteron 44, Esteron 245, a half-and-half mixture of these two Esteron products, Naugatuck, Activated Brushkill, and Cyanamide. Applications were made at rates suggested by the manufacturers. To all herbicides the blueberries were highly susceptible. The best control of brush and the least harm to blueberries resulted from the applications to the new sprouts, but even here the damage to the blueberries and the recovery of the weeds were too great to warrant a general use of any of these products.

**Stump Treatments**

Treatment of individual stumps immediately after cutting on July 15 with Activated Brushkill in kerosene, Esteron 245 in kerosene, and iron sulphate were each effective on crowns of birch, witherod, maple, poplar, willow and cherry although poplar and to some extent cherry suckered from the underground root system.

**Winter Sprays**

In 1952 a winter treatment was made with Esteron 2, 4, 5-T in diesel fuel oil, at five different strengths, from 1 per cent to 3 per cent. The brush was from 2 to 5 feet tall. Applications were made on February 9 when there was a snow cover of 16 inches which remained until the middle of March. The materials were sprayed at the rate of 100 gallons per acre. All brush touched by the spray was killed to the ground but the snow cover failed to protect the blueberries.

**Petroleum Products**

In 1953 white kerosene and varsol were sprayed at weekly intervals from April 24 to May 21 on blueberries growing in an old sod composed largely of brown top and poverty grass. Treatments were at the rate of 1 pint per square yard. Most of the grass was killed at each date. There was very little injury to the blueberries on the early plots but damage was more severe on each successive date.

More details of the effect of herbicides on individual species are given on page 20.

## Chemical Fertilizers

Lowbush blueberries frequently grow on land of extremely low fertility. Nevertheless the bushes are much more vigorous and productive on fertile soil, and there is evidence that individual blueberry plants respond to fertilizer. However, applications of the major elements as well as boron, magnesium and lime, alone and in various combinations, each year and on a wide range of soil types, off the Substation, have usually increased the growth of grass and weeds to a greater extent than the blueberries. A series of plots, sponsored by the Maritime Fertilizer Council, are described elsewhere in this report. There has been some indication that applications of nitrogen in midsummer may increase the yields the following year, but this has yet to be verified. At the moment it is felt that when soils are fertile enough to grow any form of grass, it is better not to apply fertilizer.

## Preparation of Land and Propagation

The part of Field K reserved for this work was an old cultivated area, some parts showing the remains of old potato drills. It was covered for the most part with a thin stand of grasses, occasional clover, and many hawkweeds, while the characteristic wild shrub population was appearing. Six different treatments were used in 1949 on parallel single strips of one-tenth acre each. Each treated strip was alternated with an untreated area. Later these strips were divided crosswise and planted with blueberry material from various sources.

**Soil Preparations for Planting Lowbush Blueberries—1949**

1. Plowed, harrowed, seeded to oats
2. Plowed, harrowed, bare fallow all summer
3. Ammonium sulphamate, 320 pounds per acre
4. Esteron 44, 1 part to 200 parts water
5. Esteron 245, 1 part to 200 parts water
6. Esteron 44 and Esteron 245, one-half part each in 200 parts water.

**Planting Material—1949, 1950**

1. Blueberry seed, freshly extracted, sown broadcast September 17, 1949.
2. Blueberry seed, extracted and stratified, sown broadcast May 9, 1950.
3. Sods 7 inches square, from first crop field, set 3 by 3 feet, May 13-16, 1950.
4. Sods 7 inches square from sprout field, set 3 by 3 feet, May 17, 1950.
5. Rhizomes set 3 by 3 feet, May 17, 1950.
6. Rooted stems from layering beds set 3 by 3 feet May 18, 1950.
7. Lowbush seedlings from nursery set 2 by 3 on May 7, 1950.

Examination of the herbicide treatments in September 1949 showed the ammonium sulphamate had killed about four-fifths of all herbage. The Esteron 44, Esteron 245, and the two combined had killed nearly all the weeds with no grass injury. In 1950 and 1951 grass was much more vigorous on all the herbicide areas and no residual damage was apparent to any of the blueberries.

Grass has been a serious competitor to all the planting material. It has been impossible to find any new plants from the seed sown. Many of the rooted stems from the layering beds have been unequal to the struggle. Many of the sods, rhizomes and seedlings have become established but growth is extremely slow.

Since hoeing and cultivating interfere with the normal spread, a weed killer that will destroy grass without injury to the blueberries is urgently needed.

**Fall Planting—1952**

In 1952 an addition was made to the planted area. On this portion ledge rock is at plow depth and water escapes slowly. The soil was summerfallowed and planted in the early fall, as soon as the leaves fell. Four-inch sods were lifted with a golf-hole-cutter from another section of the farm for part of the area and the remainder was set with rhizomes. In late fall it became apparent that the plants were lifting out. At the first of March the ground was bare, the sods were sitting on top of the ground and all the rhizomes were lying on the ground. From this costly experience, fall planting certainly cannot be recommended on poorly drained land.

## Blueberry Breeding

If a practical means of planting lowbush blueberries is discovered it will be desirable to have productive, high quality, vigorous varieties for propagation. The wide differences known to exist between neighboring clones offers hope for selecting varieties of superior merit. Uniform fields of a superior variety could be expected to give higher yields of more saleable berries. Selection of early and late types could also extend the picking season.

The commercial fields now in production give an almost limitless choice of material and many growers have contributed sods from clones that they have liked on their own farms.

Before the opening of the Substation, the Charlotte County Blueberry Growers' Association leased a small area nearby for exploratory work. A number of attractive clones were selected and planted on this land by a committee of the Association. Different sizes of sods were used and very small pieces of rhizomes were found to root and grow freely, but the fruit crop has been negligible.

Berries of better-than-average quality have been gathered, seed extracted and sown, and several thousand seedlings set in nursery beds. No attempt has been made to date to make controlled crosses among the lowbush plants.

In handling these seedlings it has been difficult to remove the weeds and grass without disturbing the underground stems of the blueberries and when left alone the blueberries soon become sod-bound. There is a great difference in the seedlings, both in rate of growth and resistance to various leaf disorders, and fruit characters.

In most springs freezing and thawing have lifted the plants badly and it may be necessary to transfer the nursery to a location with better natural drainage.

Not enough plants, either seedlings or clones, have fruited to permit much selection. A few have been discarded for lack of vigor.

### Highbush Blueberries

A few cultivated highbush blueberries set in a sheltered private garden at Moore's Mills, three miles from Tower Hill, many years ago, although badly neglected, still survive. Since local interest was voiced it seemed worth while to try the crop under field conditions.

In 1946 some two hundred plants were set on a piece of fertile land leased by the Charlotte County Blueberry Growers' Association. This area had been cropped with turnips the year before and received 3 inches of sawdust mulch in advance of planting. Clean cultivation, usually with a cover crop of oats in late fall, annual spring applications of complete fertilizer and occasional pruning have been followed. Although the slope is not steep, some washing has occurred and the plants have not grown well.

In 1951 a more level area was chosen in Field F on the Substation. This was an old sod with a few woody plants appearing. Sawdust to a depth of 4 inches was applied and the land was cultivated thoroughly when any grass or weeds appeared above the mulch. By fall the sod was entirely rotted, the turf, sawdust and soil being thoroughly mixed to a depth of 10 inches.

In the spring of 1952 the area was set with 376 plants, which included the varieties Rancocas, Wareham, Pemberton, Jersey, Harding, Burlington, Concord, Cabot, Weymouth and open-pollinated seedlings of Kengrape. Each plant received a small handful of complete fertilizer, the land was clean cultivated until late August when a cover crop of oats was sown.

In the spring of 1953 the plants appeared unthrifty, a number had died and were replaced. What was believed to be magnesium deficiency appeared in midsummer and magnesium sulphate in solution was sprinkled on the foliage. By fall most of the plants had regained normal foliage but growth was still meagre.

In this field, ledge rock is only 1 to 2 feet below the surface and it is believed the drainage is not adequate for proper root penetration.

### Dimensions of Plots

A casual examination of any natural blueberry field reveals a great variation in the probable yields. Since clones have evidently arisen from single seeds, a wide varietal difference is naturally present. To this may be added irregularities in the soil, presence of boulders above or below the surface, depth of soil to ledge rock or hardpan, and prevalence of weeds. Square plots and long plots each have certain advantages and it seemed desirable to learn what size and shape would be most suitable. Fields have, therefore, been lined off at picking time into plots one rod square and yields of clean berries tabulated. Data has been examined statistically for several years and it is of interest to note the great

divergence in yields within short distances. The analyses were made by H. B. Cannon and H. F. Beingessner, Horticulture Division, Central Experimental Farm, Ottawa, and are briefly summarized as follows:

SUMMARY OF YIELD DATA FOR DIMENSIONS OF PLOTS

| Year | Field | Number plots picked | Yield per acre in bushels | | |
|---|---|---|---|---|---|
| | | | Highest | Lowest | Average |
| 1949 | H | 216 | 222·0 | 12·0 | 88·0 |
| 1950 | L | 72 | 31·6 | 4·1 | 13·3 |
| | G | 100 | 40·8 | 0·8 | 10·5 |
| 1951 | L | 72 | 68·3 | 14·2 | 22·1 |
| | G | 100 | 56·1 | 10·8 | 30·2 |
| | $C_2$ | 100 | 70·8 | 18·4 | 48·3 |
| 1952 | $C_2$ | 100 | 44·4 | 8·3 | 15·5 |
| | H | 216 | 66·6 | 3·5 | 28·1 |
| 1953 | L | 72 | 70·0 | 22·7 | 36·6 |

Each study revealed a very high coefficient of variability. In 1949, in Field H, this factor was reduced from 40 per cent to 20 per cent by grouping plots 1 by 3 rods. In the same field in 1952, the coefficient was lowered from 45 per cent to 18 per cent in a 1- by 4-rod grouping.

In 1950, variability in Field L was reduced from 43 per cent to 23 per cent by grouping in 2 by 3 rods, while in Field G a grouping of 1 by 3 rods brought the figure from 70 per cent down to 43 per cent.

Grouping the yields for the two years 1950 and 1951 together, blocks of 2 by 3 rods in Field L reduced the coefficient of variability from 35 per cent to about 13 per cent, with a correlation for the two years of 0·440.

In Field G, 1 by 3 rods brought the figure down from about 40 per cent to 25 per cent, correlation in the two years being 0·224. The plots in Field $C_2$ were less variable than others with about 28 per cent variation in single plots. A 2- by 3-rod grouping reduced the coefficient of variation to 13 per cent.

In 1952 a small but significant correlation between the 1949 and 1952 yields on Field H was found, the figure being 0·365. In the latter year variability was again reduced from 45 per cent to 18 per cent by a 1-by 4-rod block and three treatments. In Field $C_2$ the correlation coefficient for yields of identical plots in 1951 and 1952 was only 0·135, and was not significant.

From these studies it is evident that experimental error is reduced by the use of long narrow plots, but in all of the fields the natural differences are still too great for simple comparisons of treatments. The need for further investigation of plot techniques is indicated.

A wide seasonal fluctuation in yields is apparent. The year 1950 was one of generally small crops, and both Field L and Field G gave higher yields for the second crop than for the first. It has been of interest to observe the proportion of plots that were consistently high or low producers and a few correlations have been possible.

ROTATION OF YIELDS IN SUCCESSIVE YEARS

| Field | Years compared | Number of Plots | | | | Total |
|---|---|---|---|---|---|---|
| | | High yield after high | Low yield after low | High yield after low | Low yield after high | |
| G | 1950-51 | 22 | 39 | 21 | 18 | 100 |
| $C_2$ | 1951-52 | 25 | 32 | 17 | 26 | 100 |

An examination of these figures suggests that the plots that were consistently high or consistently low contained a fair proportion of annual fruiting clones, with the remainder possessing some evidence of biennial bearing. While this assumption may be correct, there is also the possibility that plots that retained or reversed their position, in succeeding years, may have bloomed at a more or less favorable period for pollination; temperature or moisture supply may have been influenced by proximity to ledge, boulders, or weeds; or some may recover more rapidly from the effects of burning.

The development of desirable varieties that could be readily propagated vegetatively would simplify many other problems of blueberry research.

## FERTILIZER AND MULCHING EXPERIMENTS

*E. M. Taylor*

In 1948 a series of blueberry plots sponsored by the Maritime Fertilizer Council was located at Tower Hill, Whittier Ridge, and Pennfield in Charlotte county for the purpose of determining the value of commercial fertilizer and sawdust mulch for application to the blueberry crop.

Six square plots one-tenth acre in size were located in each area. Each plot was divided crosswise in both directions to make four one-fortieth-acre plots. One-half of each large plot was treated with 1 inch of sawdust as a mulch and the remainder left unmulched. The plots were then divided at right angles to the sawdust application and fertilizer treatments as follows were applied on one half of the mulched area and one half of the unmulched area.

Each plot thus consisted of—

¼ section fertilized
¼ section fertilized and mulched
¼ section not fertilized and mulched
¼ section not fertilized and not mulched

Fertilizer treatment was as follows:—

Plot 1 600 lb. per acre 9-5-7 applied every 3 years
Plot 2 200 lb. per acre 9-5-7 applied annually
Plot 3 600 lb. per acre 9-5-7 applied every 3 years plus 500 lb. per acre ground limestone in 1948
Plot 4 200 lb. per acre 9-5-7 applied annually plus 500 lb. per acre ground limestone in 1948
Plot 5 300 lb. per acre ammonium nitrate applied every 3 years
Plot 6 100 lb. per acre ammonium nitrate applied annually.

Three crops have been harvested from each of these plots and yields to date on each one-fortieth-acre plot were recorded.

In the aggregate, mulching without fertilization gave the highest yield and unmulched fertilizer plots gave the lowest yield. Plots fertilized and mulched yielded practically the same as the check plots which makes it appear that value of the mulch was offset by the fertilizer.

The vegetative response from the use of fertilizer has been conspicuous. Bush growth of the blueberry is more vigorous and foliage greener and larger where fertilizer has been used. Likewise, fertilizer has stimulated some competitive growth such as grass, legumes, weeds, and woody plants. The increase that was obtained from the use of a sawdust mulch was largely made at Whittier Ridge. The greatest difference between a complete fertilizer in comparison with ammonium nitrate also occurred at this particular location.

Results to date do not justify any quick conclusion that fertilizers will increase blueberry yields. Observations indicate that they do stimulate vegetative growth.

A comparison of complete fertilizer with ammonium nitrate where mulch was used indicates better crop yields from the complete fertilizer. The difference between the two treatments on the unmulched plots is small or not significant. Under mulched conditions yields on limed plots were reduced.

Mulching with sawdust has apparently increased the overall yield but a large part of this increase was obtained in one area.

## INSECTS IN RELATION TO BLUEBERRY CULTURE

*C. W. B. Maxwell, G. W. Wood, W. Neilson*

Investigations on the insect fauna in the blueberry fields of Charlotte county were initiated in 1946, involving studies on: (1) species that are annually of economic importance, (2) species that periodically are of economic importance, (3) species that feed on blueberry, but do not rank as pests.

Since 1947, annual surveys have been made to determine the distribution and abundance of blueberry insects in Charlotte county. The life-histories, habits, and control of several species of importance were studied in the insectary and field. Progress made on each important pest is presented below.

### Blueberry Maggot (*Rhagoletis pomonella* Walsh)

The blueberry maggot is the most injurious insect pest of the lowbush blueberry in New Brunswick and also in the neighboring State of Maine. Maine authorities have done a considerable amount of research on this insect, and at present recommend a 50-10-40 combination of calcium arsenate, monodehydrated copper sulphate, and hydrated lime for its control. This recommendation is currently being accepted by growers in New Brunswick.

Investigations in New Brunswick have shown that calcium arsenate dust alone gives better control than the 50-10-40 copper-arsenate combination. The former, however, has the disadvantage of being readily washed off by rain, and may cause severe burning of the foliage.

Tests are being made with a converted orchard mist blower (Okanagan type), using concentrated bordeaux mixtures with calcium arsenate. The bordeaux-calcium arsenate spray has been as effective as calcium arsenate dust in controlling the maggot, and has superior sticking qualities. The use of the mist blower, however, has the disadvantage of demanding more traverses across the treated area than the dusting equipment.

The adequacy of the conventional power duster has been investigated. Foliage was taken at regular intervals from dusted fields at Tower Hill and analyzed for arsenic content. The duster gave a very irregular coating of arsenic in the treated areas. For example, along the line of traverse the foliage might have an excess of arsenic, whereas in other parts of the field the amount of arsenic was insufficient to give effective control of the maggot.

An increase in maggot abundance in 1952 prompted many growers to bring fruit samples to the field laboratory to be examined for maggot content. In 1952, 45 tests were made for 14 growers; in 1953, 63 tests were made for 37 growers. The information obtained from the tests was useful to the growers and to the laboratory as well, as it gave an estimation of maggot prevalence.

A study of the adult emergence period was begun in 1953.

**Black Army Cutworm (*Actebia fennica* Tausch)**

The black army cutworm occurs in outbreak form at intervals of several years. In 1944 and 1945 it destroyed hundreds of acres of blueberries in Charlotte county. Following the outbreak the population subsided to low levels.

The biology and population trends of this species have been and are being studied, estimates of populations being obtained annually by sweeping representative blueberry fields during the period of larval activity.

A brief summary of the information obtained on the life-history of the cutworm is given herewith. Overwintering larvae emerge from the soil early in April, and feed at first on the blueberry blossoms and leaf buds and later on the foliage. Normally the cutworms feed at night, but in outbreak years they may feed during the day as well. They cease feeding early in June and pupate in the soil. After a pupal period of approximately one month they emerge as moths. The eggs are laid in August but do not hatch until early in October. One female may lay as many as 400 eggs. The young larvae spend most of the time in the duff and do very little feeding. They go into hibernation in the soil before the end of November.

In dusting experiments, conducted in a number of heavily infested areas in 1945, 3 per cent DDT dust, used at 40 lb. per acre, gave effective control.

**Chain-Spotted Geometer (*Cingilia catenaria* Drury)**

The chain-spotted geometer is also a periodic pest of blueberries. Fortunately, however, blueberries do not appear to be the preferred host plant. This was demonstrated during the summer of 1949 when two separate infestations were found in Charlotte county, one at Utopia and the other at Whittier Ridge. The Utopia infestation occurred on a bog that consisted chiefly of lambkill *(Kalmia angustifolia* L.*)*. Blueberry fields surrounding the infested area were not attacked by the geometer. It is quite probable, however, that if the population in the infested area had been large enough to deplete the supply of lambkill, the blueberries would have been attacked as well. At Whittier Ridge about 28 acres of blueberries were infested. The infestation was first apparent on June 27. Foliage was stripped in part or completely from the majority of plants—both sprouts and crop fields. Sprouts were more seriously injured than the older plants because of the smaller amount of foliage available in a given area. The larvae began to pupate early in August, and defoliation was terminated at this time.

On July 9, 1949, seven ¼-acre plots, in an infested sprout field at Whittier Ridge, were dusted with varying rates of 3 per cent DDT dust. The relative effects of the different amounts per acre were measured by sweeping the plots at intervals of two and seven days after dusting. The results are shown in the following table.

RESULTS OF 3 PER CENT DDT APPLICATIONS

| Plot | Rate of application (lb. per acre) | Population density (Larvae per sweep) | |
|---|---|---|---|
| | | July 11 | July 16 |
| 1 | 60 | 0 | 0 |
| 2 | 40 | 0 | 0 |
| 3 | 30 | 1 | 0 |
| 4 | 20 | 13 | 5 |
| 5 | 15 | 92 | 44 |
| 6 | 10 | 155 | 70 |
| 7 | Check | 493 | 525 |

The results show that effective control of the chain-spotted geometer may be obtained by using 3 per cent DDT dust at 20 lb. per acre.

**Blueberry Flea Beetle (*Altica sylvia* Malloch)**

On June 8, 1947, a blueberry grower from Honeydale reported considerable insect damage in his blueberry field and asked for assistance. Examination of the field showed that it was infested with larvae of the blueberry flea beetle. Following this report several fields at Tower Hill and other parts of Charlotte county were found to be infested with this pest. While the majority of the infested areas were small and spotty, the Honeydale infestation covered an area of approximately 100 acres.

The larvae or grubs are black in color and about $\frac{3}{8}$ of an inch in length when full-grown. They prefer blossoms but also feed on the foliage. Damage is most severe in first-crop fields, particularly on the hummocks or knolls. The adult beetle, which appears in early July, is roundish, shiny, coppery-bronze in color and less than $\frac{1}{4}$ inch in length. It has the habit of jumping suddenly when disturbed. The adult beetle feeds on the foliage.

Three per cent DDT dust and 70-30 gypsum-cryolite dust were used against the larvae at Honeydale and at Tower Hill. Both dusts, applied with a Niagara hand duster at approximately 30 lb. per acre, were effective. Applications of arsenate of lime at 5 lb. per acre resulted in complete control of the adult beetle. In this experiment a power root duster was used. Since growers regularly apply calcium arsenate in early July for control of the blueberry maggot, a special dust application for the adult flea beetle would be unnecessary.

**Blueberry Thrips (*Frankliniella vaccinii* Morgan)**

The blueberry thrips is an annual pest of the lowbush blueberry. Damage by this insect, however, is spotty and of relatively minor importance, being confined to patches that are heavily infested. In such patches nearly every plant is affected and very little fruit is formed. In some fields an estimated 35 per cent of the blueberry plants have been infested.

Thrips injury becomes evident by the first week in June, and may be recognized by the characteristic inward curling of the leaves. Affected leaves turn reddish in color. The thrips apparently prefer terminal leaves. In sprout fields all the foliage may be wrapped about the stem, but in crop fields the injury is confined to single or perhaps two or three leaves. The thrips itself is very

difficult to see with the naked eye as it is very small and spends most of its life cycle within the curled leaves. The adult thrips is yellowish gray and less than 1/16 of an inch in length.

A detailed study of the life-history and ecology of the blueberry thrips was begun in 1950. A considerable amount of information has been obtained and technical publications on this species are being prepared.

In experiments on the control of the thrips, 5 per cent DDT dust, and parathion, malathion and DDT sprays showed promise when applied late in May. Applications made after the leaves had curled gave little or no control.

#### Blueberry Sawflies

During the 1948 season larvae of an unidentified species of sawfly were prevalent in several blueberry fields in Charlotte county. Fortunately, however, they did not seriously affect the crop.

American authorities report that sawflies have in the past caused considerable damage to blueberry in Maine, in one instance having completely defoliated 50 acres.

In 1950 a study of the life-history and ecology of sawflies affecting blueberries was begun. Several species are present in the fields, but *Neopareophora litura* (Klug) and *Pristiphora idiota* Nort. are the principal pests of blueberry. Considerable information on the biology of these species has been obtained.

#### Other Blueberry Insects

In addition to the pests already discussed, a number of other insects have been observed feeding on blueberry. Over 40 species of climbing cutworms have been collected during the past seven years. The blueberry tipworm, *Contarinia vaccinii* Felt, and a beetle, *Serica cucullata* Dawson, have been prevalent in some fields, but appear to be of no immediate economic importance.

#### Publications

MAXWELL, C. W. B. 1950. Field observations on the black army cutworm, *Actebia fennica* (Tausch.), and its control in New Brunswick. Scientific Agriculture 30: 132-135.

WOOD, G. W. 1951. An annotated list of lepidopterous larvae from commercial blueberry fields, Charlotte County, N.B. Canadian Ent. 83: 241-244.

WOOD, G. W., W. T. A. NEILSON, C. W. MAXWELL and J. A. MCKIEL. Life-history studies of *Spaelotis clandestina* (Harr.) and *Polia purpurissata* (Grt.) in lowbush blueberry areas in New Brunswick. (Accepted for publication by Canadian Ent.)

## DISEASES OF THE NATIVE BLUEBERRY

*J. F. Hockey*

The diseases affecting native blueberries received little serious study in Canada prior to 1949. Surveys of blueberry fields were made at periodic intervals to determine some of the diseases present and the results were published in the Canadian Plant Disease Survey. However, since the establishment of the Tower Hill Blueberry Substation more attention has been paid to this crop and studies have been undertaken on the more apparent diseases causing crop losses.

Studies on witches' broom and red leaf have brought out no new information to date but these are briefly mentioned below so that growers will have some knowledge of their cause. Leaf spots have been given considerable study in the laboratory at Kentville and a number of fungi have been isolated from spotted leaves but the story on their ability to produce disease is still somewhat confused. Most attention has been devoted to the study of blossom and twig blight and the effect on blueberries of some of the more common fungicides. The experiments with fungicides were necessary to find what chemicals could or could not be used with safety on native blueberries.

**Witches' Broom (*Calyptospora goeppertiana*)**

The name witches' broom is a most appropriate description of the symptoms of this fungus disease of blueberry. The fungus invades the stem, causing it to swell to twice its normal size and also to branch profusely and produce a typical broom effect. The disease appears year after year in the same clone and is therefore called systemic. Little or no fruit is produced on affected plants. The fungus causing the disease spends part of its life on the balsam fir and must alternate between the fir and the blueberry. It does not spread from one blueberry plant to another but only from the fir to the blueberry and vice versa. The fungus appears in June or July as yellow powdery spots on the needles of fir.

The only known protection from the disease is to remove fir trees from the vicinity of blueberry fields. This will prevent new infections but it will have no effect on blueberry plants now affected. Cutting off the witches' broom plants below ground level sometimes stimulates new growth which is free from the disease. This practice, however, is useless where an entire clone is affected.

**Red Leaf (*Exobasidium vaccinii*)**

The disease known as red leaf appears in patches in blueberry fields throughout the Maritime Provinces. It is most conspicuous during May, June, and early July when the plants exhibit pronounced red to pink foliage. On examining this foliage closely it will be found to be slightly thickened and on the lower surface of the leaves a matted or powdery grayish-white layer of fungus is present. By midsummer the affected leaves drop, and the crop on such plants is usually very small. The fungus causing red leaf also attacks a number of plants closely related to the blueberry. No satisfactory control is known for this fungus. Frequent burning has appeared to reduce red leaf in some fields but there is still insufficient knowledge on which to base specific recommendations for the control of this disease.

**Blossom and Twig Blight**

Blossom blight and twig blight are descriptive terms for disease conditions commonly found on blueberries following wet bloom periods. Two fungi have been found associated with these blights in New Brunswick and Nova Scotia (*Botrytis cinerea* and *Monilinia vaccinii-corymbosi*). The latter fungus was originally described from the highbush blueberry but it also affects the lowbush species. Affected leaves turn brown, wilt, and droop along the twigs. Blossoms are similarly browned and cling to the twigs. Both fungi frequently grow into the young wood of the twigs for a short distance and produce the twig-blight symptoms. Later in the season the *Monilinia* fungus attacks the fruit and causes a mummy-berry condition in which the fungus overwinters. Most of these mummied fruits are discarded when the berries are cleaned, hence it is advisable to destroy by burning the winnowing piles that may be left in or near blueberry fields. The *Botrytis* fungus overwinters on dead twigs and plant debris.

Studies on these diseases have shown that the fungus spores are present in the spring and ready to cause infection during spells of wet weather at blossom time. Fungicide experiments have revealed that blossom and twig blight can be greatly reduced by two or three applications of 10 per cent ferbam dust. The first application should be made at the time the first leaves and blossoms appear, with two subsequent applications at about 10-day intervals, until the bloom is past. For best results the applications should be made at a rate of 15 lb. per acre and previous to prolonged wet weather. The dust may be applied when the bushes are wet.

**Miscellaneous Tests with Fungicides**

Several available fungicides have been used on blueberries during the past few years to determine their effect on the plants. Bordeaux mixture has been used with safety at concentrations ranging from 5-15-100 to 20-15-100 with no injury. Basicop and Perenox both caused flecking spots on the leaves and sometimes a brown scorching. The organic materials, Phygon, Ziram, and Ferbam appeared quite safe but Crag 341, now known as glyodin, caused severe injury to the blossoms. The organic mercury materials were all toxic to the plants and cannot be used on blueberries.

A series of replicated spray experiments conducted near Kentville, N.S., in 1952 compared the materials bordeaux mixture, tribasic copper sulphate, and ferbam. The three materials gave an increased yield of fruit over the control plot. The plots sprayed with ferbam produced the largest berries and also had the least amount of blossom blight.

During 1953 a series of dust treatments was made near Tower Hill to compare sulphur dust and 10 per cent ferbam dust. Little or no disease was observed on the plots but the ferbam-treated plot gave a significantly greater yield of fruit than the sulphur-treated or untreated plots.

The above series of fungicide tests indicated that ferbam is the least toxic fungicide on blueberries and also gives satisfactory control of blossom and twig blight. For these reasons the dust form is recommended for the spring treatments of native blueberries in areas where disease appears to be a serious factor in crop production.

During the course of these studies D. W. Creelman and later C. L. Lockhart performed most of the detailed work. The absence of Mr. Lockhart on prolonged sick leave during 1953 and early 1954 has interrupted the work contemplated. Acknowledgment is made to these two men for much of the information given above.

## ECOLOGICAL STUDIES

*I. V. Hall*

The production of fruit from the native blueberry has increased in importance during the past few years. As a result, many new areas have been brought into production and efforts have been made to stimulate older areas to greater production. The declining yields and increasing weeds after years of continuous cropping were problems of first importance. The methods used in establishing new blueberry areas by burning abandoned hayfields and second-growth woodlots raised additional questions. These problems showed the necessity of studies on the succession of plant species, the interrelationships of the several components of the plant communities existing in both old and new blueberry fields, and the effect of various cultural practices on the economic *Vaccinium* species.

## Species of Vaccinium

The classification of the species of *Vaccinium**, even in the small area around Tower Hill, is made difficult by the presence of many intermediate plants. These are undoubtedly of hybrid origin, resulting from the crossing of closely related species. After a seedling reaches a height of 1 or 2 inches it starts to spread by underground runners to form a patch of bushes among the parent species and a mixture of intergrading forms develops in a field. Judging from the number of intergrades between *V. myrtilloides* and *angustifolium* at Tower Hill, the genetic relationship between these two species must be very close. There were considerably fewer hybrids between V. *angustifolium* and its variety *nigrum* and this would suggest that the black-fruited plants might better be classified as a separate species, *V. brittonii*, as some workers have suggested. To date no hybrids between *Vaccinium myrtilloides* and *Vaccinium angustifolium* var. *nigrum* have been found. The foxberry and cranberry are also in the genus *Vaccinium*, but are so unrelated to the blueberries that no hybrids between them could be expected.

## Successional Studies

### A. Cleared Woodland

Data obtained from ecological plots located at Tower Hill Substation, on a forest site referred to as Field M, indicate that burning immediately after clearing is not the answer to quick establishment of blueberry fields. The foliage cover occupied by sour top blueberry *(Vaccinium myrtilloides)* has remained relatively constant. The number of plants was very low at the start and has not increased during four years of observation.

Within deep coniferous woods, generally a few very weak plants of lowbush blueberry, *(V. angustifolium)* and sour top can be found on careful search. These have the appearance of seedlings, but are actually very old plants that date from the time the woods were formerly cleared. They never flower or fruit and do not develop because of the insufficient light. They may even receive some nourishment from the plants in adjacent fields to which they are connected by their deep rhizomes. Although they are surviving as insignificant stems, they will develop rapidly as soon as given more light. They, and not seedlings, are undoubtedly the critical source from which new blueberry stands are established after clearing. All attempts should be made to preserve and encourage their growth. A hot fire or grazing immediately after cutting the trees would eliminate them quickly. When pulpwood has been selectively cut and the forest canopy opened up, vigorous blueberry plants can be found wherever the light penetrates. This was observed in a number of woodlots examined.

By allowing the blueberry plants to grow for a period of four to five years before clear cutting there is an opportunity for food material to build up in the rhizome and give a reserve of food to the sprouts after burning. A check of a number of commercial fields that had been established by not burning during the first five years showed that good stands of blueberries had been obtained within a period of approximately ten years.

Field observations at Tower Hill show that optimum establishment of blueberries has been obtained by clearing and burning the woodland at a rate equal to the growth of the rhizome from an established field. By this method the boundaries of a producing field are increased by approximately 2 feet per year.

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* Scientific nomenclature follows Gray's Manual of Botany, 8th Edition by M. L. Fernald.

**B. Abandoned Hayfield**

A series of four permanent plots (5 by 1 rods) were delimited in Field F in 1949 and treated according to the description in the following table.

AREA OCCUPIED BY BLUEBERRIES IN PERCENTAGES

| Treatment of plots | V. angustifolium | V. myrtilloides |
|---|---|---|
| A—burning every three years | 26 | 2 |
| B—burning every year | 32 | 12 |
| C—mowing twice per year | 1 | 1 |
| D—control—vegetation allowed to take its own course | 18 | 1 |
| —Average of six good commercial fields | 83 | 7 |

The above four plots were considered to be uniform at the commencement of the experiment in 1949. The data reveal that burning hastens the establishment of blueberry plants; burning every year is superior to once every three years. *Vaccinium angustifolium* increased more than any other species on the burned plots.

Analysis of soils from these four plots showed the samples taken as representatives of the four treatments to be significantly alike in chemical character. The change in the flora is not due to changes in the physical and chemical nature of the soil.

## Weeds of Blueberry Fields

Weeds in blueberry fields are all those plants that reduce the growth of the blueberry plants or interfere with cultural and harvesting practices and, in general, are those species that, like the blueberry, survive the burning treatment. Fire, which destroys everything to the surface of the ground, is used to prune the bushes in commercial blueberry fields. The blueberry fields are covered with straw in the fall and burned the following spring. During the first year only vegetative growth occurs in the form of vigorous sprouts arising from the underground rhizome. Flowers and fruits appear in all subsequent years but only two crops are taken before the fields are reburnt because there is too high a proportion of woody growth in relation to the area where fruit buds develop.

**A. Weed Control by Burning**

The practice of burning blueberry fields has been successful in eradicating the highly inflammable evergreens, chiefly *Picea glauca* (white spruce), *Abies balsamea* (balsam fir), and *Juniperus communis* var. *depressa* (common juniper). *Prunus pennsylvanica* (pin cherry) and the shallow rooted grasses such as *Danthonia spicata* (poverty grass) are similarly destroyed. *Spiraea latifolia* (hardhack, elsewhere called meadow-sweet) has been partially controlled. It is necessary to apply some other treatment to plants not controlled by burning.

**B. Weed Control by Chemicals**

General experiments on the use of chemical weed killers have been described on page (7) of this report. In order to learn the effect of these materials on specific plants, the spot-spraying method was used to obtain the following information.

Two different types of chemicals have been used in experimental weed control at Tower Hill, namely, 2,4-D and related compounds and volatile oils. *Rosa carolina* (wild rose), *Kalmia angustifolia* (lambkill), and *Rhododendron canadense* (rhodora) are highly resistant to a straight 2,4-D application. Much success has been obtained with a mixture of equal parts of 2,4-D and 2,4,5-T. At 2,000 p.p.m. it has been possible to effectively control *Salix* spp. (willow),

*Betula populifolia* (wire birch), *Kalmia angustifolia, Rhododendron canadense* and *Cornus canadensis* (bunchberry). *Alnus crispa* var. *mollis* (alder), *Rosa carolina, Populus tremuloides* (poplar) and *Viburnum cassinoides* (witherod) are more resistant, requiring double the concentration, 4,000 p.p.m. Even this strength has given only partial success on *Populus* and must be applied during the early part of the spring. Suckers from the stumps of *Acer* spp. (maple) are resistant to 2,4-D and related compounds.

Varsol and kerosene will kill the current year's growth of the interrupted fern, *Osmunda claytoniana* and also grass. Spraying with volatile oils causes considerable damage to the blueberries. *Populus tremuloides*, treated by dipping the ends of the stems in varsol will lose its leaves for a period of two weeks but will eventually develop new ones.

These tests indicate that spot spraying may be an effective control for clumps of woody perennials with little damage to blueberry plants.

**C. Weed Control by Cutting**

A general outline of the effects of brush cutting in Field J has been given on page 7 of this report. The brush of this field has been cut once a year for the past five years, plots being cut each month from May to October. A botanical record was taken on August 28, 1953, by stretching 100 yards of twine and noting the plants that touched the line at one-yard intervals.

WEEDS PERSISTING AFTER DIFFERENT MONTHLY CUTTINGS EXPRESSED IN PERCENTAGES

| Plants | May | June | July | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| Bare ground | 1 | 1 | 1 | 3 | 7 | 6 |
| Moss | 1 | 6 | 14 | 4 | 9 | 7 |
| Grasses and sedges | 7 | 10 | 8 | 10 | 11 | 2 |
| Willows | 11 | 5 | 1 | 2 | 1 | 8 |
| Poplar | 7 | 2 | ..... | 1 | 4 | 9 |
| Wire birch | 10 | 6 | ..... | ..... | 7 | 14 |
| Hardhack | 9 | 16 | 14 | 11 | 14 | 14 |
| Cinquefoil | 7 | 3 | 3 | 5 | 3 | 1 |
| Blackberry | 1 | 5 | 4 | 4 | 1 | 2 |
| Clovers | 5 | 1 | ..... | 1 | 7 | 3 |
| Lambkill | ..... | 1 | 1 | 6 | 1 | 2 |
| Sour top blueberry | 1 | 2 | 6 | 13 | 3 | 4 |
| Lowbush blueberry | 2 | 5 | 14 | 21 | 6 | 5 |
| Witherod | ..... | 1 | 1 | ..... | 2 | ..... |
| Goldenrods | 30 | 29 | 29 | 17 | 20 | 20 |
| Asters | 5 | 6 | 1 | 2 | 1 | 1 |
| Pearly everlasting | 2 | ..... | ..... | ..... | ..... | 2 |
| Hawkweeds | 1 | 1 | 2 | ..... | 2 | ..... |
| Others | ..... | ..... | 1 | ..... | 1 | ..... |
| | 100 | 100 | 100 | 100 | 100 | 100 |

From the table it is evident that willows, poplar, wire birch and clovers are controlled more effectively by cutting in July and August than early or later in the season. The blueberries are most numerous on the July and August plots.

**D. Weed Control by Grazing**

The purpose of the experiment was to determine the extent of damage done by sheep to blueberry bushes under conditions of intense grazing. It was hoped that the sheep would eat the weeds and lessen the competition for the blueberries. The experiment was carried out on Field D (in sprout crop) of the Blueberry Substation where two areas 146·5 by 141 feet, were enclosed with a snow fence.

On June 29, 1953, the sheep were observed for a period of 2½ hours. The older sheep grazed the blueberries 127 times, or approximately 4·4 per cent of the grazing time. There was no grazing of *Vaccinium myrtilloides;* the majority grazed were *Vaccinium angustifolium* var. *nigrum* rather than *Vaccinium angustifolium*. The stems and leaves of this variety in a sprout field were very succulent and the sheep ate them without hesitation. In areas where there were intermittent patches of grasses and blueberries the sheep always preferred the grass.

During the last week of August, fifteen line transects were placed within the experimental plot. A twine string with twenty points marked at one-yard intervals indicated the plant present either grazed or ungrazed.

SELECTIVE GRAZING OF SHEEP

| Plants | Plants grazed | Plants not grazed |
|---|---|---|
| Bare ground | | 1 |
| *Polytrichum commune* (moss) | | 9 |
| *Pteridium aquilinum* (bracken fern) | 1 | |
| *Agrostis tenuis* (brown top) | 44 | 10 |
| *Carex spp.* (sedge) | 1 | |
| *Spiraea latifolia* (hardhack) | 68 | 20 |
| *Trifolium repens* (white clover) | 10 | 1 |
| *Kalmia angustifolia* (lambkill) | | 1 |
| *Vaccinium myrtilloides* (sour top blueberry) | 1 | 9 |
| *Vaccinium angustifolium* (lowbush blueberry) | 2 | 100 |
| *Vaccinium angustifolium* var. *nigrum* (black lowbush blueberry) | 1 | 3 |
| *Solidago rugosa* (goldenrod) | 13 | 1 |
| *Solidago graminifolia* (goldenrod) | 3 | |
| *Hieracium pilosella* (hawkweed) | | 1 |
| Totals | 144 | 156 |
| | 300 | |

Brown top, hardhack, white clover and goldenrod were heavily grazed while blueberries were not grazed by the sheep. In one corner of the area where there was a high percentage of *Pteridium aquilinum* (bracken fern) the sheep had completely destroyed or eaten the tops. In a neighboring plot where sheep had not been grazing, bracken population was from 22 to 25 plants per square yard. In the grazed area there were no plants of *Solidago* spp. (goldenrod) and *Spirea latifolia* (hardhack) in blossom. The adjoining plot where no grazing had occurred appeared yellow due to goldenrod blossoms, and many of the hardhack plants were producing seeds.

On the basis of one year's observation it appears that sheep grazing offers an excellent means of weed control in blueberry fields the year following the burn.

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