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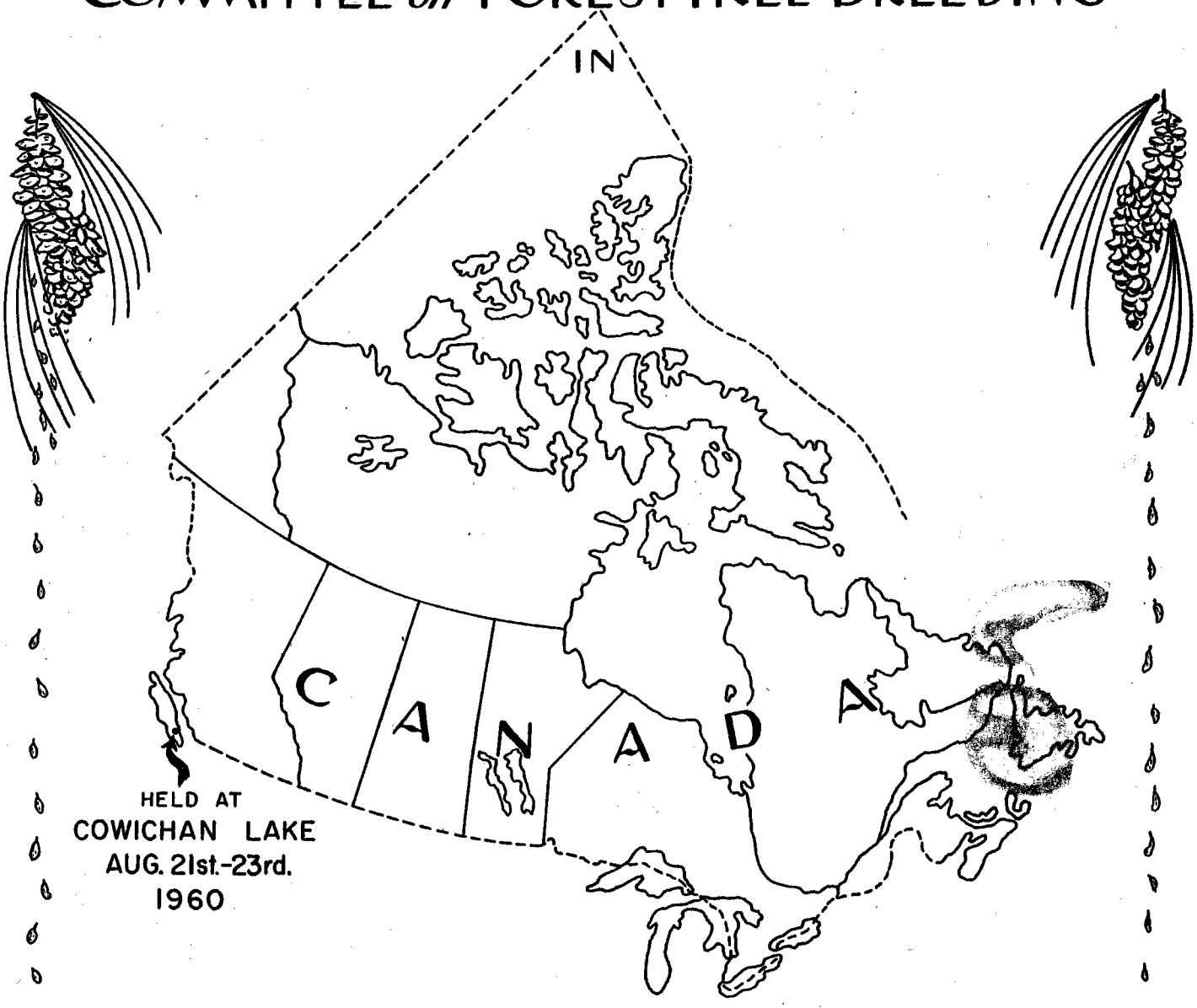
Proceedings of the Seventh Meeting OF THE COMMITTEE on FOREST TREE BREEDING IN CANADA



Part II
Reports and Reviews

PROCEEDINGS OF THE SEVENTH MEETING OF

THE COMMITTEE ON FOREST TREE BREEDING

IN CANADA

Held at the Forest Experiment Station of the British Columbia Forest Service, Lake Cowichan, Vancouver Island, B.C., on August 21st to 23rd, 1960.

PART II

MEMBERS' PROGRESS REPORTS AND VISITORS' PROGRAMME REVIEWS

Prepared and distributed by the Forest Research Branch, Canada Department of Forestry, Ottawa. Part I, Minutes and Discussions, received restricted distribution to Committee members only. Part II received wider distribution to persons and organizations actively engaged or interested in forest tree breeding and improvement.

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NOT FOR PUBLICATION

REPORT TO COMMITTEE ON FOREST TREE BREEDING

July 1960

Michael G. Boyer

Canadian Department of Agriculture
Forest Biology Laboratory
Quebec, P.Q.

Investigations have been undertaken since 1958 on diseases of poplar present in the Province of Quebec, with particular emphasis on their effect on hybrid and introduced poplars.

At the present time, introduced poplars are not widely distributed in this Province. Only three plantations have been established; the Harrington Forest Farm (C.I.P.) at Calumet, the Morgan Arboretum at Montreal and the Forest Biology Laboratory at Quebec City. Approximately 33 diseases have been recorded on poplar in the Province, many of them at present established on introduced poplar. The identified fungous diseases of introduced and native poplars in Quebec are presented in Table I.

Diseases

1) Ciborinia pseudobifrons Whetzel

2) Ciborinia whetzelii (Seav.) Seav.

3) Cladosporium subsessile Ell. Barthold

4) Didymosphaeria populina Vuill.

5) Dothichiza populea Sacc & Br.

6) Fusarium solani sensu. S. and H.

7) Fusicladium radiosum (Lib.) (Lind.)

8) Guignardia populi Thompson

9) Hypoxylon pruinatum (Klot.) Cke.

10) Linospora tetrospora Thompson

11) Marssonina populi (Lib.) Magn.

12) Marssonina rhabdospora (Ell. & Ev.) Magn.

13) Melampsora abietes-canadensis (Farl.) C.A. Ludwig

14) Melampsora medusae Thüm.

15) Mycosphaerella populicola Thompson

16) Mycosphaerella populorum Thompson

17) Mycosphaerella populorum (canker phase)

18) Nectria canker

19) Neofabraea populi Thompson

20) Septotinia populiperda Waterm. & Cash

21) Taphrina johansonii Sadeb.

22) Taphrina populina Fr.

23) Uncinula salicis (DC) Wint.

24) Valsa nivea (Hoff.) Fr.

25) Valsa sordida Nit.

TABLE I

Fungous diseases of native and introduced poplars in Quebec

Native poplars

Populus alba var. nivea	11, 25 *
" balsamifera	4, 10, 11, 13, 14, 15, 16, 23, 25
" grandidentata	6, 11, 14, 16, 19, 21, 24, 25
" deltoides	2, 3, 7, 9, 11, 13, 14, 16, 18, 23, 24, 25
" tremuloides	1, 2, 3, 7, 8, 9, 11, 14, 16, 18, 21, 23, 24, 25

* numbers refer to diseases listed previously

TABLE I (Continued)

Introduced poplars

Populus alba x grandidenta 7, 11, 14, 25

" angulata x simonii 10, 11, 25

" berolinensis x simonii 11, 16, 17

" candicans x berolinensis 11, 16, 20, 25

" charkowiensis x caudina 11, 14

" charkowiensis x incrassatta 11

" charkowiensis x robusta 11, 25

" deltoides x balsamifera 11, 14, 20, 25

" deltoides x petrowoskyana 5, 11, 16

" deltoides x trichocarpa 11, 25

" deltoides x volga 11, 25

" eugenii 1, 11, 14, 25

" euramericana 10, 11, 14

" euramericana x serotina 11, 14

" generosa 11, 14

" grandidentata x alba x grandidentata 7, 14

" marilandica 11, 14, 20

" maximowiczii x berolinensis 16, 25

" maximowiczii x plantierensis 11, 14, 16

" maximowiczii x trichocarpa 11, 14, 16

" nigra x laurifolia 10, 11, 14, 16, 20

" nigra betulifolia x volga 11, 16, 25

" nigra italici 11, 14, 21

" nigra betulifolia x trichocarpa 14, 20

Oxford poplar 16

TABLE I (Continued)

Populus pacheri 11

" petrowoskyana 11, 14

" rasmowskyana x plantierensis 20, 25

" raverdeau 11, 14, 16, 25

" robusta 14, 16, 25

" sargentii 11, 16

" serotina 11, 14

" tremula 11, 14

" tremuloides x tremula 11, 14

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ONTARIO
DEPARTMENT OF LANDS AND FORESTS

Reforestation

Toronto, Ontario

FOREST TREE BREEDING

August, 1960

Hon. J. W. Spooner
Minister

F. A. MacDougall
Deputy Minister

J. A. Brodie, Chief
Timber Branch

REPORT TO COMMITTEE ON FOREST TREE BREEDING

August 1960

* A. J. Carmichael, B.Sc.F. R.P.F.

Ontario Department of Lands and Forests

I Provenance Tests

A. White Spruce

The existence of nutritional deficiencies has been indicated by foliar analysis in a white spruce provenance test. The test was established in 1958 at Artemesia township in south-western Ontario, in co-operation with the Petawawa Forest Experiment Station. The pale colour of the foliage and the poor growth led to foliar sampling in fall 1959. Test results indicated a low level of nitrogen (less than 1.0%) and potassium (less than 0.36%) in three replicate plantings of the one seed source tested. This source (Essa Tp.) came from an area high in calcium and magnesium, and the soil at the planting site was derived from dolomitic limestone also high in its calcium and magnesium content. A further analysis is required, to determine whether another source from a high lime area shows similar deficiencies, and to compare these findings with those for a source from acid soil conditions.

A point is raised by these observations concerning the need for caution in selecting planting sites for provenance tests to avoid soil deficiences and for the necessity of having planting stock with an adequate nutrient content. Further information is required to develop norms for the nutrient requirements of different seed sources in seedling and transplant stages. Deficiencies induced by nursery management may obscure any ecotypic variation present and invalidate conclusions based on measurements of growth.

B. Red Pine

In addition to the nutrient condition of stock plants there are insect and disease complexes which affect provenance tests. Apart from the interaction of these, there are the organisms which develop on normal stock in plantations. A condition has developed in red pine provenance test plantings at Rose township in Central Ontario and in German township in Northern Ontario which is being studied to define the causal agents.

* Employed in the Reforestation Section of Timber Branch, Allan J. Carmichael is responsible for carrying out the forest tree breeding program of Timber Branch.

Foliar analyses of healthy and unhealthy red pine of Algoma source obviate the explanation of reduced vigour due to a nitrogen, phosphorous or potassium deficiency. The levels of minor elements will be checked in 1960 to evaluate their status: however, it seems that a disease or virus pathogen is responsible for the tree mortality and that this may be vectored by an insect.

C. Scotch Pine Christmas Tree Test

Measurements of height growth and form were made for test plantings of 12 seed sources growing in central and northern Ontario (Rose and German townships) which were 7 years old from seed. A similar planting at Cambridge township in the Ottawa valley could not be measured.

None of the sources planted at German township will produce satisfactory Christmas trees. Northern conditions on a medium quality jack pine site, produced slow growth and a sparse branching habit with shorter needled foliage than in southern plantings.

French sources, grown from seed obtained from Établissements Versepuy, grew too slowly in every planting to develop a satisfactory Christmas tree, i.e. 6 ft. within 7 years from seed. These sources will require generally at least 10 years to reach merchantable size. The needle retention and fall colour for French sources surpassed all others: however, the short needles produce an open tree requiring rather heavy pruning and this extends the period to reach merchantable size.

A rapid growing source called West Europe, sold by F. W. Schumacher, Jamaica Plains, produced the greatest number of merchantable trees. Proper development of this source would necessitate annual pruning to produce suitably formed trees, and cutting would have to be done early in the fall to avoid too high a percentage of yellowish trees.

The best source in Rose township was West Baltic obtained from F. W. Schumacher. Trees had a moderate growth rate, produced an adequate number of branches per whorl (8) were straight-stemmed and retained their colour reasonably well in the fall.

Scandinavian sources from Sweden and Finland have produced trees with very straight stems, and in Rose township some trees of Swedish source have obtained excellent form. However, fall discolouration of the foliage would prevent this source from ever being considered for Christmas trees.

A mixed source originating from plantations at St. Williams nursery in Southern Ontario, is included in a 1956 planting to be examined in 1961. This source is preferred by some Southern Ontario growers who have made comparisons with other sources available from seed dealers in the United States and Europe. It currently provides the only source grown for Christmas trees in Ontario government nurseries.

II Seed Orchards

A. General

The propagation of selections from northern and central Ontario continues, with the emphasis being placed on black and white spruce (Fig. 1,2). Criteria for the selection of spruce in Seed Zone 5 of Northern Ontario have been adopted to aid in the elimination of individual specimens from the rank of plus trees.

The preliminary outline of these characteristics is as follows:

WHITE SPRUCE

Primary Any one factor is sufficient cause to eliminate a tree.

1. Site Index below 75 (total height 75 ft. in 50 years breast-height age), using the Lake States F.E.S. Tech. Note 474, Jan. 1957. This rating may have to be reduced to S.I. 70 for Port Arthur District in recognition of the reduced growth rate caused by continued attacks by spruce budworms.

2. More than one terminal shoot or past attempt at twinning.

3. Moderate to excessive spiral grain.

Secondary A few factors in combination or individually in excessive degree, are sufficient cause to eliminate a tree, particularly if the tree is a borderline case for any primary factors.

1. An inactive growing point at the tree apex (less than 1 ft.).

2. Broad, oval crown with irregular branching habit, particularly when one or more branches stand out from the crown in the upper third of the tree.

3. A small diameter or excessive taper, representing low wood volume for the tree.

4. Pendulous branches with a branch angle greater than 110°.

5. Heavy or numerous persistent branches as exemplified by a poorly cleaned stem. These branches are usually longer than 10 ft.

6. An asymmetrical bole or one which shows excessive fluting or butt flare or swelling due to buttress roots.

7. Large vole scars or depressions at the branch root, often associated with gum bleeding.

BLACK SPRUCE

The factors are similar to those for white spruce except that trees are eliminated, which have on uplands a Site Index rating below 50 (total height 50 ft. in 50 years breast-height age), and in swamps a rating below Site Class I (total height 36 ft. in 50 years breast-height age).

The upland data referred to are from the Lake States F.E.S. Tech. Note 473, Jan. 1957, and the swamp type data from Dr. Plonski's Normal Yield Tables, L. & F. Rep. No. 24, 1956.

B. Red Pine

A red pine seed orchard has been established at Grenfell township in Northeastern Ontario, to supply seed for the eastern portion of Zone 5. Plantings of about 1 acre in size were carried out in 1959 and 1960 following a plan designed to promote pollen dispersal. The basic unit within the orchard has been a block containing 144 trees (12 representatives of 12 clones) planted at a uniform spacing of 15 ft. x 15 ft.

Trees used for the orchard planting were grown in the nursery for 3 to 4 years following grafting. Stock should have been pruned in the third year in the nursery but was prevented until data were available to define the proper pruning time. Plants were moved as balled stock and planted at spots prepared by hand cultivation, with the addition of ½ cu. ft. shredded peat moss in each spot.

Foliar analyses for orchard plants after the first field season indicated nitrogen and phosphorous deficiencies. These were remedied in the spring of 1960 by broadcasting Ammonium Nitrate (500 lbs. per acre) and Triple Superphosphate (200 lbs. per acre) on a 4 sq. ft. area surrounding each plant.

The movement of orchard stock in closed polythene plastic sleeves, 18 in. wide x 36 in. long, tied at both ends with twistem wire, has improved the vigour of plants lifted early in the season for shipment to the north. Planting is simplified also, since removal from the plastic sleeve is accomplished by unfastening the basal wire tie and releasing the tree into a prepared hole. Fall lifting of red pine and cool storage overwinter in plastic bags at a northern location was carried out in 1959 to prevent shoot growth prior to the planting period. Clear plastic sleeves (3 mil) have been used and these were placed in burlap bags to prevent damage by exposure to sunlight.

C. Black Spruce Wood Quality

In order to obtain a means of mapping the natural variation of different wood characteristics found in black spruce, a sampling technique is required. An ivestigation was prepared in co-operation with the Forest Products Laboratory to measure some of the physical wood properties of black spruce trees, and to relate these to measures made on breast-height increment core samples. When a sampling technique is available, it will be possible to determine what variation is present for such factors as specific gravity, fibre length, fibril angle and summerwood percent, and hence to map this variation. An obvious advantage for a method requiring only increment cores, is that it does not destroy the subject but leaves desirable trees for future propagation.

Five trees of good form were selected from the dominant height class on wet sites in both Fournier and Challies townships, and on drier sites in both Kennedy and Leitch townships. The north side of each tree was marked and the tree felled. Trees were sectioned to remove 8 in. blocks at stump level (10 in.) breast-height level (54 in.), and at each 100 in. level above the ground to a 3 in. top diameter (4 in. top diameter in Kennedy Twp.).

In Ottawa, sample blocks will be sectioned and analysed to determine the average specific gravity, fibril angle, fibre length, fibre diameter and summerwood percent for an optimum location at each height level in the tree. Specific gravity will be determined also on 5/8 in. increment cores taken at breast-height on minimum, maximum and average radii, and measurements will be made for each 20 year group of annual layers from the bark to the pith. Precautions will be taken to avoid compression wood in the selection of specific gravity samples. Any doubtful selection will be verified by a check on fibril angle since this angle is greater in compression wood fibres.

Before samples were sent to Ottawa, the growth rings were counted on the upper surface of each block and diameter measurements made by decades along an average diameter. These measurements have been plotted to show the relationship of height to age and height to diameter.

From this data, tree volumes have been calculated and annual volume increments determined. As would be expected there is a close relation between total volume and total age, with the oldest trees being the largest and having the greatest average annual volume increment. The most noticeable exception to this is tree 294 from Kennedy township. This is the youngest tree sampled but it is the third largest tree and has the largest average annual volume increment, .22 cu. ft. per year. If we look at the volumes of the different trees at 100 years of age, we find that there are similar differences between townships and that the relationships between trees changes, showing a few trees which have poor volumes and were apparently suppressed, and one tree 294 with very good volume (Fig. 3 and 4).

Fibre analyses must be completed before it will be possible to compare the various trees for volume and quality combined. It will be most interesting to see how tree 294 fares. Will it have a low density as would be expected normally, or will it be the type of tree we are looking for, having superior volume increment with high density and the fibre yield required for a special tree.

III Seed Production Areas

A. General

Potential areas have been located for white spruce in Zone 5 (Northern Ontario), for black spruce in Zones 4 and 5 (Central and Northern Ontario), and for red pine in Zones 2, 3 and 5 (Southern, Central and Northern Ontario). Additional areas are required but are difficult to locate since there are few young stands available which are pure, even-aged and growing on sites that are drier than normal for the species.

B. Red Pine, Lynn Tract, Simcoe County

Red pine were thinned to a spacing of 12 ft. x 12 ft. in 1957 and flower and cone counts have been made annually following thinning. Individuals were selected in fall 1959 which showed a consistently low flowering pattern for trees growing on sites providing adequate tree growth.

On each of three sites, four trees were selected with three to be fertilized and one to form a control. Foliar analyses were made for each tree in fall 1959 and these show a uniformly low nitrogen level and uniformly adequate levels of phosphorous and potassium.

Three nitrogen levels (1.50%, 1.75% and 2.00%) will be held in the foliage of the treated trees on each site. By annual foliar analysis the effects of treatments can be measured and succeeding fertilizer applications modified to maintain the required foliar levels. The application of nutrients other than nitrogen will be made when the foliar analyses indicate inadequacies. Cone production will be examined to see how the size of cone crop or the frequency of crops has been affected by the three nitrogen levels maintained.

Figure 1

TREE SELECTIONS

WHITE SPRUCE

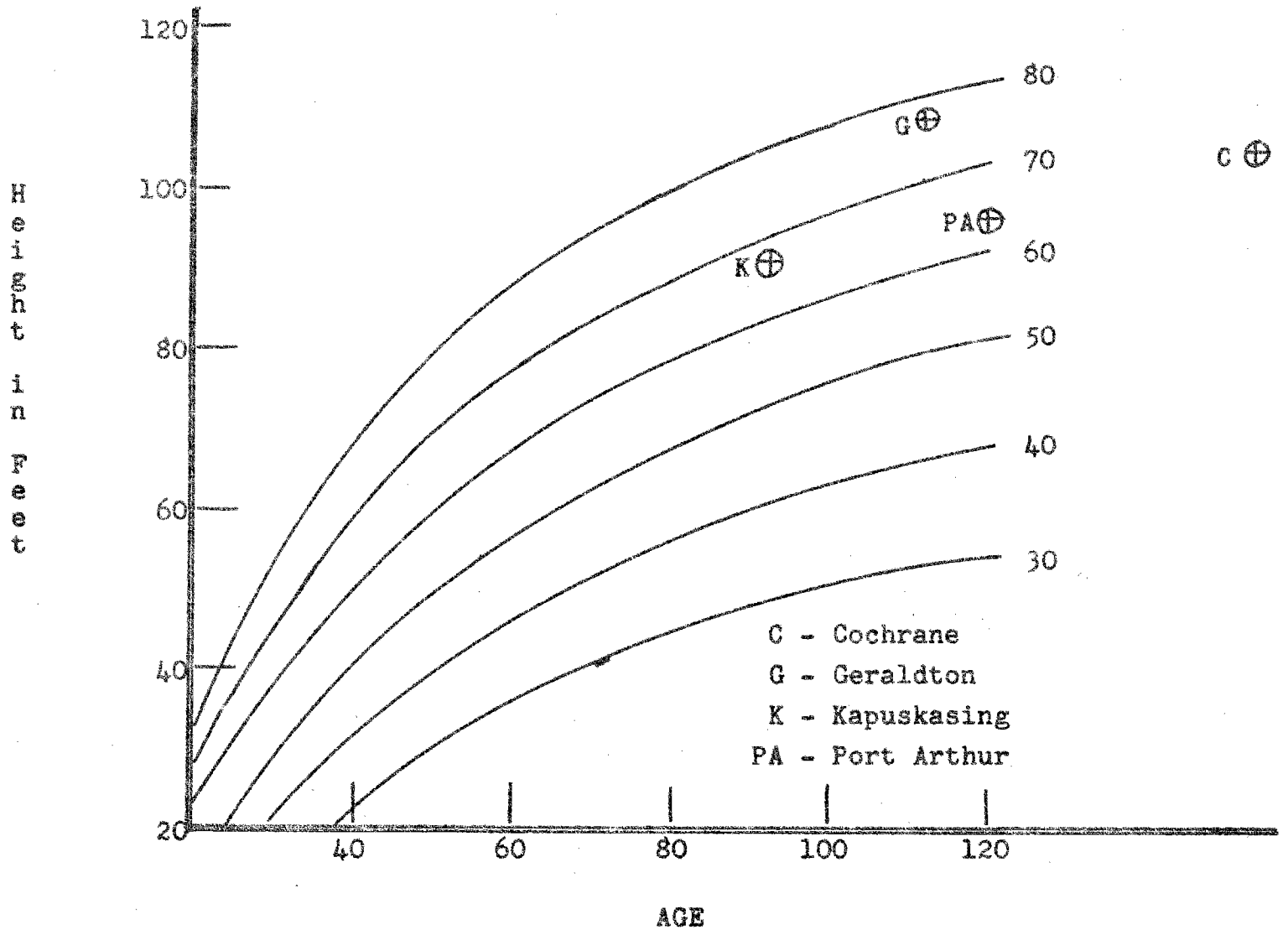


Figure 2

TREE SELECTIONS

BLACK SPRUCE

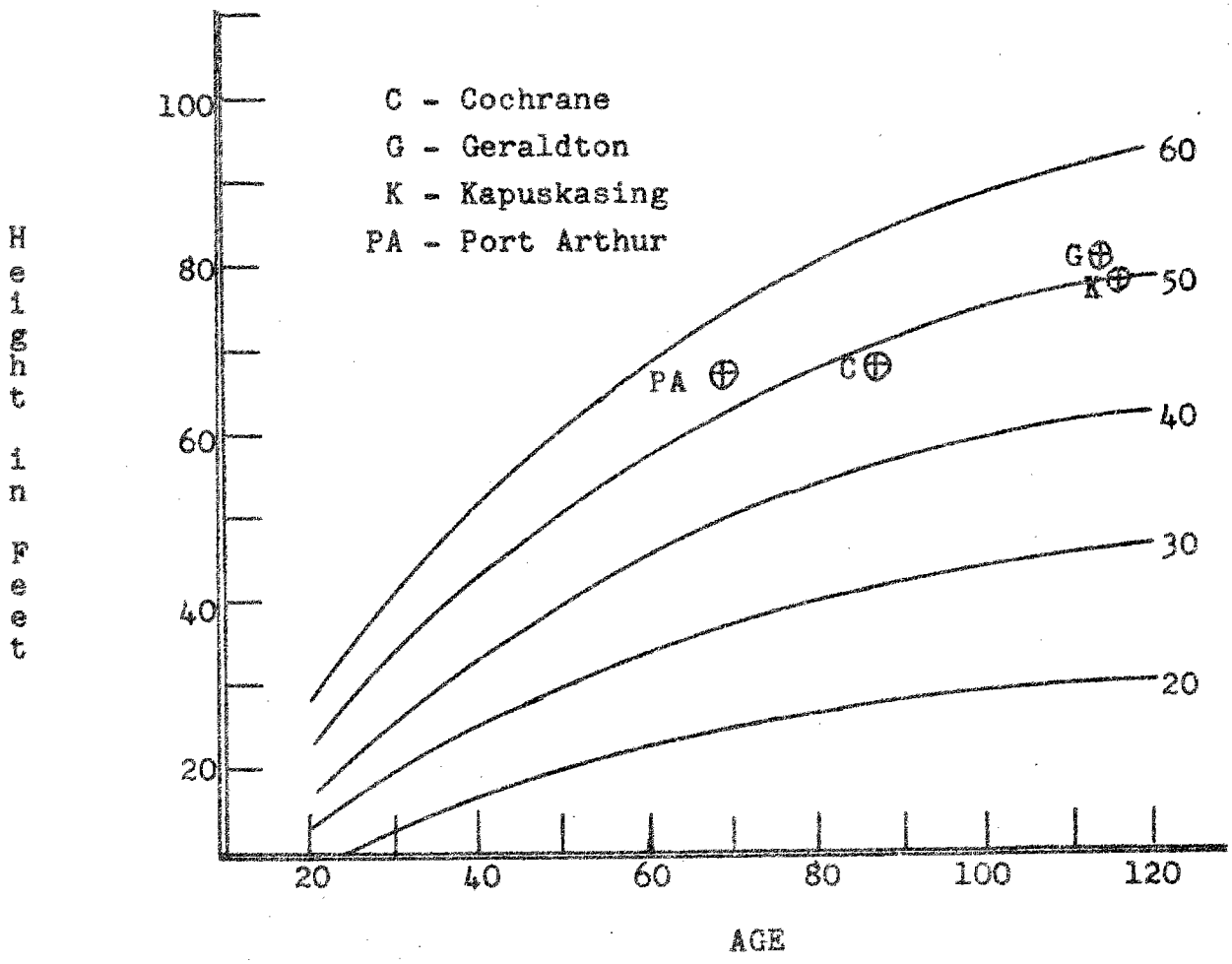


Figure 3

BLACK SPRUCE WOOD QUALITY

TOTAL TRUNK VOLUMES AND AVERAGE ANNUAL VOLUME INCREMENT

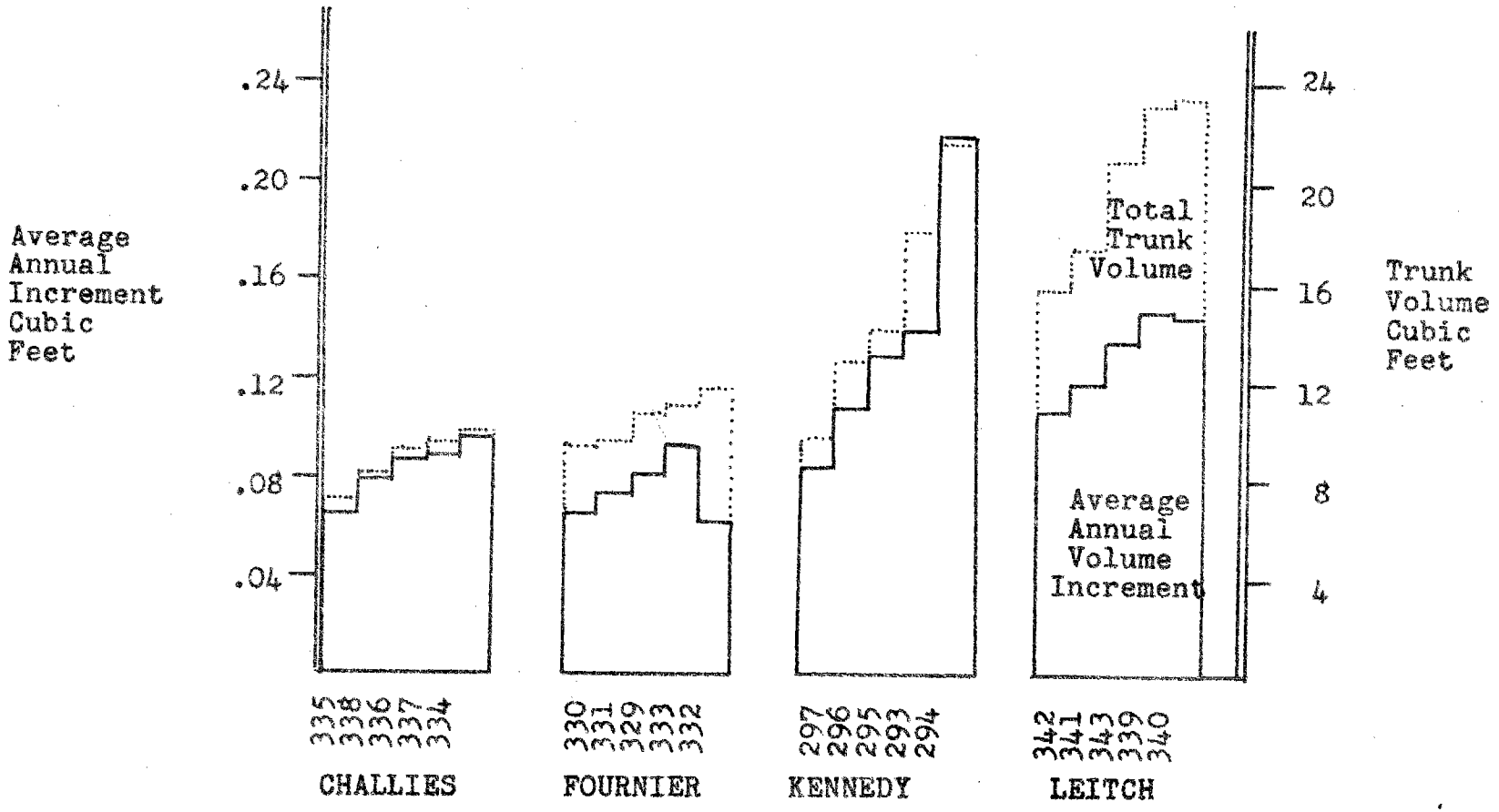
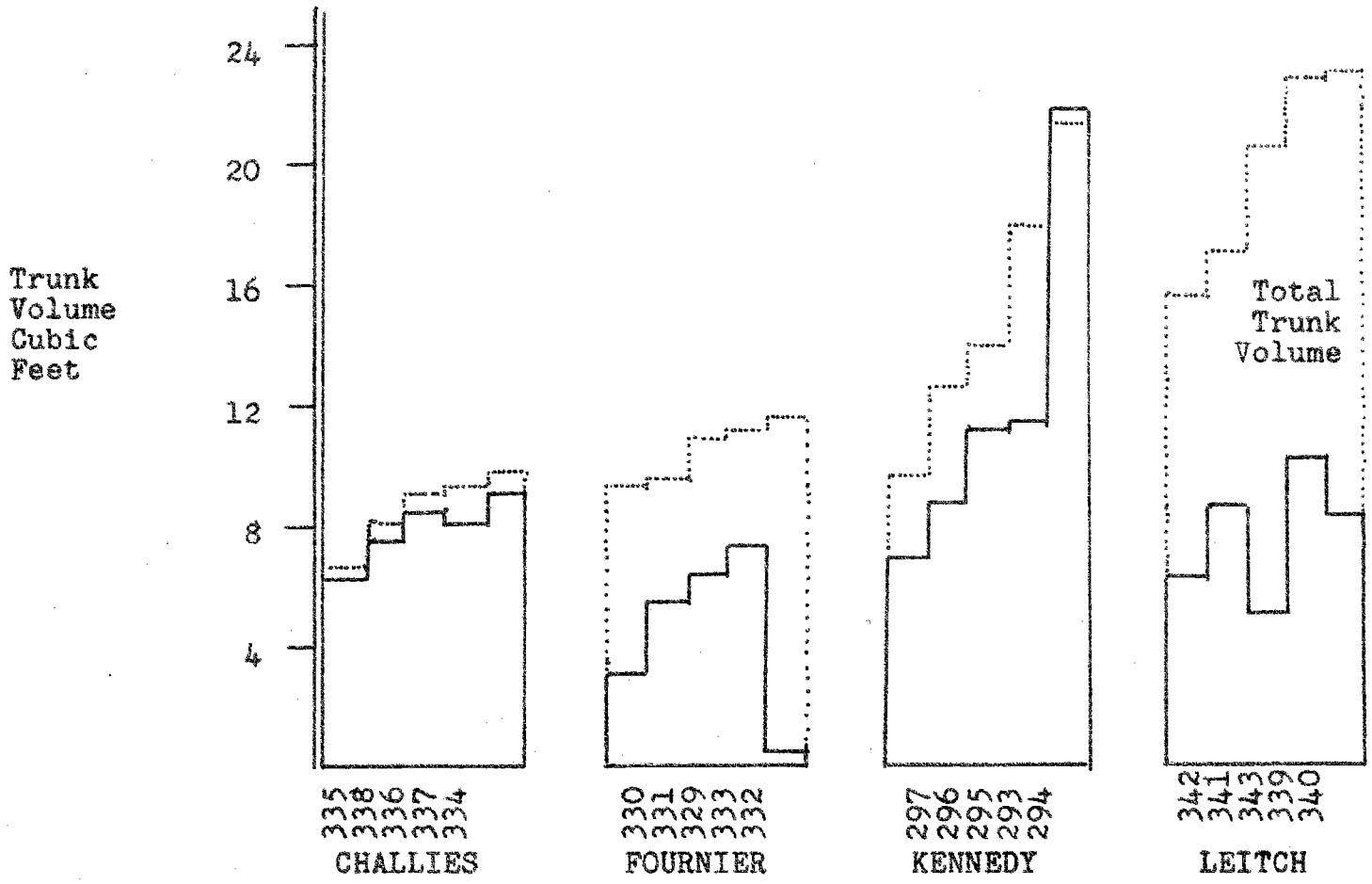


Figure 4

BLACK SPRUCE WOOD QUALITY

TOTAL TRUNK VOLUME AND VOLUME AT 100 YEARS



1960 Report on Tree Breeding Research

L. P. Chiasson St. Francis Xavier University
Antigonish, N. S.

Since the last report facilities for genetic research on the campus have been increased by the erection of a greenhouse by the Nova Scotia Research Foundation. Several projects had to be interrupted during the past winter owing to the loss of most of the glass in this greenhouse as the result of a fire in a neighboring building.

Interspecific Hybridization in *Abies*.

The principal programme of investigations has been and still is the production of interspecific hybrids of fir (*Abies*) species. In the last two years, ovulate cones of *A. balsamea* had been artifically pollinated with "foreign" pollens of the following species: *A. cephalonica*, *A. grandis*, *A. homolepis*, *A. homolepis* var. *umbellata*, *A. nobilis* var. *glauca*, *A. Veitchii*. Seeds had been obtained from most isolated cones, but it remained to test whether or not these putative crosses were real hybrids or, possibly, the results of self-pollination. In defiance of the proverbial injunction not to "put all your eggs in one basket," all these putative hybrid seeds were planted in the greenhouse after stratification. Indoor planting was resorted to for the following reasons: difficulty in getting outdoor seed-beds ready at the proper time was anticipated, and it was considered that sorting true hybrids from possible self-fertilized types would be more easily achieved under greenhouse conditions. Germination of these seeds was generally good, but the seedlings had not been subjected to careful examination when they were killed by heat and frost.

In the spring of 1960 artificial crosses have been attempted with A. balsamea as the female parent, and pollen of the following Abies species: cephalonica, concolor, homolepis, homolepis var. umbellata, koreana, lasiocarpa, and nordmanniana. These pollens have been applied to isolated cones on groups of trees located in four well-separated areas within a radius of 10 miles of Antigonish.

Ovule Development and Fertilization.

A study has been made of the "timing" of various stages in the development of the ovule. The occurrence of a 4-6 week lag between pollination and fertilization has been confirmed. During this lag there is no evident change in the pollen grains until they come in contact with the nucellus, at which time processes of germination become apparent.

In view of the short period of time each spring for the task of artificial pollination, the possibility of "late" artificial pollination is being explored. Two methods are being tested: the injection of pollen between the closed scales of previously isolated cones, and the injection of pollen through artificial openings bored in the scales before the time of fertilization. No results are as yet available as to the practicality of these methods.

Pollen Germination.

Studies of pollen germination have been instituted. These are intended to check the adequacy of some common and simple germination tests with respect to pollen of various Abies species. Since some of the pollens used may be transported considerable distances and may be in transit for

varying periods of time, some general test of viability is desirable. Tests performed to date with various concentrations of sucrose and of lactose in water or in agar do not indicate gross differences in response on the part of 10 different Abies species.

Dormancy Studies.

Two decelerating features of a genetic programme in conifers are the production of flowers at an advanced age, and the necessary period of dormancy during the fall and winter months even under greenhouse conditions.

The variability of results obtained by the experimental application of gibberellic acid (GA) has given hope that almost any physiological effect might be produced in a hitherto untested species. Two sets of experiments have been performed with GA, one in the field and one in the greenhouse. In the field growing tips of firs 7-10 years old were sprayed periodically with GA dissolved in distilled water in some instances, and in Dermen's mixture in others. (Dermen's mixture contains morpholine and lanolin, and appears to provide good continuous contact with the foliage.) Floral formation has not been induced by these treatments; the collection and analysis of the information concerning possible effects of GA on vegetative growth have not been completed yet.

Greenhouse experiments were initiated with young fir trees (mostly 3-4 years old) brought in from the field at intervals from mid-November to February. Different concentrations of GA were sprayed on undisturbed and on artifically open vegetative buds. There were some indications that dormancy had been broken by the application of GA, but the numbers were not

statistically significant, and the experiment could not be carried to its anticipated conclusion.