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NATIONAL RESEARCH COUNCIL OF CANADA

PROCEEDINGS

OF THE

TWENTY-FOURTH MEETING

OF THE

SUBCOMMITTEE ON FOREST TREE BREEDING

ASSOCIATE COMMITTEE ON FORESTRY

OTTAWA

5 MARCH 1952

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Initial Distribution.

NATIONAL RESEARCH COUNCIL

PROCEEDINGS OF THE TWENTY-FOURTH MEETING OF THE

SUBCOMMITTEE ON FOREST TREE BREEDING

ASSOCIATE COMMITTEE ON FORESTRY

Held in Lecture Room, Forest Products Laboratory, Metcalfe and Isabella Streets, Ottawa, 5 March 1952, at 2 p.m.

Attendance

Mr. H.D. Heaney, Chairman
Mr. A. Bickerstaff
Mr. R.S. Carman
Mr. S.J. Cook
Mr. M.B. Davis
Mr. J.L. Farrar
Mr. J.D.B. Harrison
Mr. J.M. Holst
Dr. A.W.S. Hunter
Mr. A.W. McCallum
Dr. C.C. Heimburger, Secretary

269. Minutes

The minutes of the twenty-third meeting were APPROVED.

270. Business arising out of the minutes

The question of a summary report on the progeny of superior trees (see item 253) was again mentioned. Since the Associate Committee on Forestry has become inactive it was decided that the establishment of a working committee for the preparation of such a report was no longer warranted.

271. Dr. Cram's report

Dr. Cram sent his report by mail. It was received after the meeting and could thus not be discussed.

His report is found in Appendix "A"

272. Dr. Heimburger's report

The report of Dr. Heimburger on breeding of white pine and poplar was read. (see Appendix "B") The favourable results in obtaining plant materials from abroad were pointed out. Through the cooperation of the Forestry Branch and the Department of External Affairs it was possible to obtain plant materials in good

condition from Japan and Pakistan and to work out procedures for obtaining further breeding materials from distant localities abroad. Further co-operation with the Forestry Branch is planned in work with white pine for possible resistance to weevil at the Petawawa Forest Experiment Station, and in raising and testing of red pine and related species for possible resistance to the European shoot moth. At the appropriate stages of development further co-operation with the entomologists of the Division of Forest Biology will be enlisted. During the discussion Mr. Holst mentioned the information he had obtained from the New York State Commission of Conservation about the resistance of Japanese black pine (P. Thunbergii) to the European shoot moth. There are now1/0 seedlings of 20 strains of Austrian pine at the Petawawa Forest Experiment Station that could be of possible value in this connection also.

273. Mr. Holst's report

Mr. Holst presented a preliminary report on strain tests with white spruce and Norway spruce at the Petawawa Forest Experiment Station. White spruce of Petawawa origin was found to be more vigorous than several western strains. Norway spruce has vigorous growth but is susceptible to weevil. Seeds of several strains of Norway spruce have been obtained and it is planned to test this material for adaptability to different parts of Canada, also to look for resistance to weevil if this is found. Observation plantations are planned in co-operation with the Ontario Department of Lands and Forests, Division of Reforestation. These should in time result in tree observation plots. Experiments in partial girdling and application of fertilizers to induce flowering in red pine have been started. Materials for strain tests with red pine, Austrian pine, European larch and European white birch have also been assembled. Scaffolds for pollination work have been built around two large red pines. Fifteen thousand white pine transplants have been set out in a strain-test plantation in co-operation with the Ontario Department of Lands and Forests.

In the discussion, Dr. Heimburger recommended tests with white spruce from the interior wet belt of British Columbia and similar regions in western Canada and the United States as being of promise to eastern Canada because of more sustained growth and resulting large sizes as compared with eastern strains of the same species.

Mr. Harrison mentioned that arrangements have been made to obtain microfilm records for various meteorological stations in an effort to assemble weather data for provenance tests. In this connection it was questioned to what extent is Lesser Slave Lake white spruce showing slow growth in eastern Canada also slow growing at its place of origin.

Dr. Heimburger suggested that photoperiodic response might be a factor causing slow growth of this strain when grown appreciably to the south of its native area.

274. Dr. Hunter's report

Further work in the breeding of elms for resistance to the

Dutch elm disease was reported (see Appendix "C"). One triploid white x Chinese elm seedling was obtained in 1949. Further crosses of Ulmus americana x pumila were successful in 1951. It was possible to propagate elm from softwood cuttings in a greenhouse during June after soaking them for 24 hours in a 50 ppm. solution of indolebutyric acid. The cross black currant x red currant was made for the purpose of obtaining sterile Ribes plants for work with white pine blister rust. Some seeds were obtained and have been sown.

During the discussion Mr. Holst recommended the propagation by cuttings, preferably taken from old trees of known growth form. He also mentioned a variety "Hoersholmii" from Denmark as being promising in work with resistance to Dutch elm disease and having good growth form.

Dr. Heimburger stated that possibilities for work with elm were now at hand at Maple, Ontario, since the disease had reached that area and work in selection and artificial inoculation was planned there by the Division of Forest Biology of the Science Service.

275. Mr. McCallum's report

Mr. McCallum presented a progress report on the distribution of the Dutch elm disease in eastern Canada to date (see Appendix "D"). The disease is now quite widespread in southern Ontario, especially in Essex county.

276. Discussion of the Article "A Tree breeding program for Canada" by I.C.M. Place

Since Mr. Place was not present at this meeting, a discussion of his article was not held. Mr. Holst stated that tree breeding work on a Canada-wide basis is valuable but still somewhat premature. At a later date comments on this article were received from Dr. Cram and Mr. Walker. These are enclosed as appendices "E" and "F" to serve as reference for possible further discussions of this article.

277. Status of the Associate Committee and Subcommittee

Mr. Harrison explained that the status of the Subcommittee still was indefinite but was under consideration. The Associate Committee on Forestry is being disbanded by the National Research Council with the approval of the Forestry Branch. It is expected that the Subcommittee on Forest Fire Research will be reorganized as an Associate Committee. With respect to the present Subcommittee in Forest Tree Breeding, the situation is different, but it is thought that this field of work will be brought under the aegis of the Forestry Branch. Mr. S.J. Cook could not say anything definite about this but hoped this question could be cleared up at the time of meeting of Council on March 21, 1952. It was possible that a small group could be established as an interdepartmental committee on biological research (federal). Mr. Bickerstaff suggested

that if a joint committee on research within the Federal Government were set up, the present Subcommittee could then continue as a subcommittee of this new committee.

It was decided to publish the minutes of the present meeting, and Mr. Cook promised to look after this.

NOTE BY MR. S.J. COOK:- At the meeting of the National Research Council held 21 March 1952 consideration was given to the matter of reorganizing the Forestry Committee. The following resolutions were adopted:-

(a) That the Associate Committee on Forestry be disbanded

(b) That the Dominion Forester be asked to assume responsibility for the activities carried on by the Subcommittee on Forest Tree Breeding (which he subsequently agreed to do - see letter from Mr. D.A. Macdonald to Mr. S.P. Eagleson dated 24 June 1952)

(c) That an Associate Committee on Forest Fire Protection be established under the auspices of the National Research Council to carry on the work previously done by the Subcommittee on Forest Fire Research.

278. Acquisition of plant material

Mr. Holst mentioned that eastern strains of Scotch pine and Norway spruce, not at present available from their native localities, are planted in several strain tests in Germany, Poland and Czechoslovakia. It has been possible to obtain seeds of such strains collected in plantations and further steps are being taken to obtain more materials of this kind. The successful acquisition of white pine materials from Pakistan and Japan has already been mentioned in Dr. Heimburger's report.

279. Equipment

Mr. Davis stated that the new truck-mounted extension ladder is now at Indian Head. In a letter received after the meeting by the Secretary, Dr. Hunter stated that Mr. Walker had nothing to report. The ladder was not received until late in the season and the weather conditions experienced last fall allowed no time or opportunity to use the ladder. However, the ladder will be put to use this year.

Mr. Heaney mentioned the tree-scaling ladder made of magnesium metal, now in use by Mr. Holst.

280. Membership and officers

Mr. Heaney stated the membership will depend on the status of the Associate Committee and Subcommittee if and when this will be clarified. Entomologists are at present very desirable as members because

several members are working actively on resistance to insects in their breeding materials and nearly all are faced with damages caused by insects in one way or another.

Mr. Heaney suggested that Mr. Farrar be reinstated as member of this Subcommittee.

Dr. Heimburger found it desirable to have a longer meeting once a year, rather than several short meetings, in case the agenda became too lengthy to handle during one afternoon.

Mr. Davis suggested that reports by active members on their work be distributed prior to the meetings, to allow fuller discussion at the meetings.

281. Disease Garden at Connaught Ranges

Dr. Hunter did not weed the white pine plantation in 1951 (see minute 264), but agreed to arrange for weeding during this year. Mr. McCallum agreed to ask Dr. Riley for any available data on resistance to blister rust of the white pine materials planted there, which had been obtained while the plants were growing at the N.R.C. Annex nursery. Mr. Holst agreed to prepare a report on the present status of the Disease Garden.

282. Adjournment

The meeting adjourned at about 5 p.m.

APPENDIX "A"

SUMMARY REPORT FOR 1951

Forest Nursery Station,
INDIAN HEAD, Sask.

(TREE BREEDING SECTION - by W.H. CRAM)

INTRODUCTION:

Gratifying progress in 1951 is reported for all authorized projects in plant breeding. This progress has resulted in the submission of two articles for publication in 1952, i.e. "Spruce Seed Viability" and "Parent-Seedling Characteristics and Relationships in Caragana".

Progress to date has been facilitated by the excellent services of Mr. Brack (Plotman) and by the whole-hearted co-operation of Mr. Walker (Superintendent).

With the natural expansion which follows as selections and progenies are obtained, present facilities are proving inadequate. Additional technical assistance, labour, and some stenographic help are urgently requested, in order to ensure economic use of existing plant material and more rapid progress with projects.

Loss of plant material and distortion of results, due to insects and diseases, continues to be serious. The assistance rendered by the staff of the Forest Biology Laboratory at Indian Head is greatly appreciated.

Caragana Breeding

Self-and open-fertility determinations which were made in the field for 39 selections exhibiting exceptional vigour, were seriously handicapped by a severe infestation of aphids in 1951. Interannual correlations, for the 1948 to 1951 data, suggest that 'seeds-harvested-per-flower-tripped' is a more reliable and consistent measure of self-fertility for caragana selections than that of 'pods-harvested-per-flower-tripped'! Due to the year to year variations obtained in fertility evaluations it would appear that field results must be verified under greenhouse conditions. To date, 12 selections have been identified as being self-sterile, or nearly so, and in addition

exhibit a high degree of open-fruitfulness. These selections constitute ideal material whereby combining ability may be determined in polycross plots, provided they are capable of being propagated vegetatively.

High interannual associations were evident between 'seeds-per-pod' values following self-pollination. This relationship suggests that the number of viable ovules per pod is an inherent character. Size (weight) of seed was found to bear no relationship to seed yield (seeds per pod), which indicates that size of seed may also be an inherent character of caragana selections rather than a factor conditioned by yield.

Circumstances of season and help forced postponement of the propagation of selections by softwood cuttings until July 17. Rooted cuttings were obtained for six of the twelve selections when collected on July 17th and on August 8th. Forty-two percent of those taken at the earlier date rooted as compared to 37% for the later date, while cuttings with 'heels' (of the older wood) demonstrated superior rooting (both dates). Some desirable selections failed to produce rooted cuttings. The need for an earlier start in this work is indicated. It is thought that the dry, hot weather prevailing in 1951 may have hastened maturity of the wood for some selections. Hardwood cuttings, which were collected in 1950 and planted in the field in 1951, gave unsatisfactory results, no doubt due to climatic conditions prevailing. The use of greenhouse facilities during the winter months is contemplated for the rooting of hardwood cuttings.

Field germination tests, with open-pollination seed of 12 sizes from 14 trees, demonstrated significant differences between seed-tree sources both for germination capacity and speed. The presence of a mild form of dormancy for seed from some seedtrees was suggested by differences obtained in germination speed. Seed sizes, ranging from 16 to 40 milligrams, appeared to have little, if any, influence upon germination. Greenhouse germination of seed harvested 23, 20, 16, 8 and 0 days prior to natural dehiscence of pods (i.e. maturity), was 36, 43, 68, 66, and 56% respectively. In addition, size (diameter) and weight of seed harvested at the above intervals increased significantly up to, but not beyond, 16 days prior to pod dehiscence. It would appear that viability of seed does not materially change in the last 16 days prior to dehiscence.

Vigor of 80-day open-pollination seedlings differed significantly for 16 seedtree sources. Average height of these progenies ranged from 9.7 to 13.7 cm. No relationship was evident between vigor of these seedlings and self-fertility of parental trees. Nevertheless, the most vigorous progenies were produced by two seed-trees, one being self-sterile and the other moderately self-fertile; while the least vigorous progenies were produced by seedtrees exhibiting a high degree of self-fertility as well as a moderate degree of self-tripping. It would appear that selections of the latter type should be

eliminated from a breeding program having vigor as its objective.

Viability of Spruce Seed

Large progenies are essential in order to evaluate spruce seedtrees as to their potential breeding value, especially when the economy of utilizing open-pollination seedlings is followed. It is evident from the following table why investigations into 'Spruce-Seed-Viability' have taken precedence over progeny tests.

Seedbed Performance of Non-Stratified Seed from Four Species of Spruce

(based on progeny tests initiated in 1949 with 1948 seed)

Spruce Species	Seedtrees Involved	Mean 1949 Germination	Transplants Produced (on basis of seed sown) Mean	Range
	(No.)	(%)	(%)	(%)
White	24	14.6	11.4	6-22
Black Hills	21	16.5	12.1	5-29
Norway	14	50.9	22.7	13-32
Colorado	36	57.9	45.3	18-69

Stratification of spruce seed for a period of two months in 1950 resulted in an average germination of 68% for the four species, as compared to 23% for non-stratified seed. From these results, it was evident that low seedbed germination was essentially due to seed dormancy. Work was continued in 1951 to determine the most congenial seed treatment necessary to ensure germination of spruce seed. The following results are reported:-

1. Colorado seed, harvested on August 15, 21, 26 and September 6 and stratified for 40 days, exhibited germination of 68, 95, 97 and 96% respectively, within 27 days. This suggests that Colorado seed may be harvested over a 16-day period, prior to natural opening of the cones on the trees, without loss in viability.

2. Stratification of seed from White and Black Hills spruce for 0, 30 and 60 days resulted in germination of 12, 64, and 78%, respectively,

within 19 days. These results indicate that stratification beyond 60-days may be necessary for such seed, for maximum germination.

3. Stratification of seed for 30 days resulted in a mean germination of 91% compared to 75% for non-stratified seed of Norway spruce, and 86% compared to 68% for seed of Colorado spruce. It would appear that such pre-sowing treatment ensures adequate seed germination for progeny tests of these two species.

Evaluation of Scotch Pine Seedtrees

Vigor data, for three-year-old (2/1) seedlings of Scotch pine, clearly demonstrate that differences existed between the progenies of 45 seedtrees. The average height of these progenies ranged from 17.1 ± 0.8 to 30.8 ± 0.7 cm. Seedling progenies from seedtrees within each geographic race of Scotch pine exhibited the following ranges in vigor:- for the Aberdeen race from 21.7 to 30.8 cm., for Finnish, 19.2 to 27.0 cm.; and for Russian from 17.2 to 24.6 cm. It would appear that all three races contain seedtrees capable of producing moderately vigorous progenies, while some seedtrees of the Aberdeen race produce the most vigorous seedlings. However, the relationship of vigor for seedlings to that of mature progenies remains to be determined. Thus, the final selection of the most desirable seedtrees must be postponed until mature progenies can be studied for vigor.

Rooting Capacity of Poplar Clones - (Exploratory)

The exploratory study involving rooting capacity determinations of poplar clones was continued in 1951 to verify the incomplete results obtained in 1950. However, no association was evident between the rooting capacity exhibited by 12 clones in 1950 and 1951. There appears to be evidence that differences between seasons resulted in a differential response for some clones in the two years. For instance, Northwest poplar demonstrated a rooting capacity of 79% in 1950 but only 65% in 1951, while the opposite trend was evident for the Dunlop poplar with 75% rooting in 1950 and 92% in 1951. It would appear that an accurate determination of rooting capacity should involve consideration of such factors as, maturity of the wood, compatibility of cuttings to storage, climatic and soil conditions at the time of planting, etc. Nevertheless, the data for two years suggest that the Volunteer clone is vastly superior to the Northwest clone in rooting capacity.

The relative vigor of shoots produced in the two consecutive years by cuttings from 12 clones was consistent, as indicated by a correlation value of .934. As a result it is clearly evident that two clones, Volunteer and FNS 44-52, are capable of producing growth in the first year, which is superior to that of Northwest poplar.

APPENDIX "B"

Report on Forest Tree Breeding

in 1951

C. Heimburger

As formerly, the work has been divided into 3 main projects: 1) white pine, 2)poplars and 3) arboretum. In addition work with red pine has been carried out on a small scale and additional results with induction of flowering by means of girdling in a young plantation have been obtained.

White pine. The assembling of breeding materials indicated in former reports has been continued in 1951 and the number of grafts was about the same as in 1950, namely 1979 successful grafts in the greenhouse, comprising 121 clones, besides some 200 grafts of 3 populations made on established plants outside. The bulk of the materials comprised scions collected from some plus-trees at the Petawawa Forest Experimental Station and from a plantation of Pinus Peuce in Finland. Additional scions of Pinus Peuce were collected in Rochester, N.Y., and obtained from several other places in Europe. This species is usually highly resistant to blister rust and it was considered important to establish a good collection of different biotypes for future evaluation and breeding work. Scions of several artificial species hybrids were obtained from the Institute of Forest Genetics at Placerville, Calif. Co-operation with the Northwestern Blister rust Control Project of the U.S.D.A. in Spokane was initiated and scions as well as grafts of apparently resistant western white pine from Idaho were received for testing under our conditions. A small test plot with these materials was established in the nursery. Through a contact established by Eric Gage, of our Department, during a trip to Europe in 1950, seeds of white pine free from blister rust under conditions of heavy infection in Germany were obtained in exchange for seeds of some of our resistant white pine. Through the co-operation of the Federal Department of Resources and Development and the Department of External Affairs, scions and seeds of the wild form of Pinus parvifloraz were received from the Japanese Ministry of Agriculture and Forestry. Portions of the seeds were distributed to the Institute of Forest Genetics in Placerville and to the Arnold Arboretum. The scions were grafted on natural white pine seedlings. This was done in late June when new growth already had started and would have been complete a failure under ordinary circumstances. Because of new techniques developed recently about half of the grafts took and we now have about 80 successful grafts of this promising strain. In the fall, scions were received of Pinus Griffithii (excelsa), collected from natural seedlings at an elevation of over 11,000 feet in the Himalayas, through the courtesy of the Pakistan Forest Research Institute, ✓cooperation of the Department of External Affairs and the Department of Resources and

Development. This material was collected near the upper limit of the distribution of the species and seeds from this elevation are usually not available. The scions were stored in snow after arrival and were grafted in the greenhouse early this year.

Several hundred hybrid seedlings were raised from the seeds harvested in 1950. No seeds were available in 1951 from the rather extensive hydridization work in 1950, because all young cones were destroyed by insects in early spring of 1951. Four new crosses were made in 1951, on a rather limited scale.

Weather conditions were unfavourable for infection with blister rust because of very pronounced Indian Summer conditions - dry, hot days alternating with cold nights continuing into the fall and leaving only a short time interval for natural and artificial infection before the onset of winter. All seedling populations were inoculated artificially, using black currant leaves. Of the grafts made in 1950, 12 clones only were inoculated. Usually the currant leaves, with well-developed telial columns, are attached to the pine grafts by means of paper clips. This time some of the currant leaves were attached with toothpicks, which obviated the necessity of the rather cumbersome removal of the paper clips after inoculation and simplified the procedure. The black currants used for the inoculation were grown in a lath house. A plantation of black currant bushes was established during 1950 in a small clearing near a moist draw in the forest at this Station. The bushes grew quite well under these conditions but showed very little natural infection and did not yield any fresh leaves at the time of pine inoculation. Currant bushes grown in the open in the nursery were infected so heavily during 1951 that by the end of the Indian Summer all leaves were dried up or had fallen.

Plants of three new kinds of Ribes were obtained, to test them as possible carriers of blister rust for future inoculation of white pine. One is Ribes diacanthum, a dioecious species, male plants of which could safely be planted in test plantations of white pine as they bear no fruit and thus could not be distributed by birds to places where they might be undesirable. The other is Ribes Gordonianum, a sterile species hybrid, having the same advantages. While R. diacanthum showed only slight infection with white-pine blister rust, R.Gordonianum was heavily infected, indicating better suitability for the above purpose. The winter hardiness of the latter Ribes under our conditions is yet uncertain but should become quite apparent in a few years. The Horticultural Division of the Central Experimental Farm in Ottawa has undertaken to raise hybrids between the black currant and red currant which possibly would be sterile and of sufficient susceptibility to white-pine blister rust to be suitable for this purpose. Another possibility in this respect is Ribes Culverwellii, a hybrid of black currant and gooseberry, young plants which were obtained late in the summer from the Montreal Botanical Garden.

A beginning has been made in the study of inherent leader thickness in white pine as this character seems to be related to weevil tolerance or resistance. The so-called slender-leader trees of the

entomologists have been found to be less susceptible to weevil attacks than trees with thick leaders. In the present work, scions are collected from trees differing in leader thickness and growing on different sites, and grafted on essentially similar stock. The grafts are then placed in essentially the same environment in the nursery. A shoot-thickness gage was manufactured by the Mechanical Section and numerous measurements of leader thickness and shoot thickness on various grafts were made. The grafts at first show a rather strong influence of the size of the original scions on their shoot thickness. Later, inherent differences in shoot thickness become apparent and the different clones become more uniform in this respect. To-date, the western white pine material assembled here shows greater interclonal variation in this respect than does the eastern white pine material. Within a relatively short time it should be possible to select the clones having inherently slender leaders in a most pronounced degree and then to use them, in combination with a high degree of resistance to blister rust, in the breeding of silviculturally more desirable new types.

In co-operation with the Division of Reforestation and the Department of Resources and Development, 10 test plantations were established with white pine transplants raised at the Midhurst Provincial Nursery from seeds collected in the fall of 1946. The test plantations are located mostly in southern and central Ontario, and one in Quebec. They comprise about 188 thousand transplants of 24 strains, including one population of western white pine from B.C. and one population raised from seeds of the Pointe Platon trees, mentioned in previous reports. The aim of this work is to analyze the native white pine in respect to its segregation into ecotypes and climatic races and to detect inherent superiority in growth form and growth rate as a basis for immediate use in reforestation and for future breeding work.

Several improvements in the grafting technique of white pine were made. In grafting of white pine in the greenhouse the procedure thus far has been to pot the stocks in late fall, plunge them into coldframes for the winter, then to thaw them out by means of an electric heating cable, and to bring them inside for forcing and grafting. In the fall of 1950 a number of potted stocks were placed directly into a grafting frame in the greenhouse and left there for the winter. The plants were never subjected to temperatures below freezing and as a result thereof did not start to put out new growth until late in March. Their foliage, cambium and roots lost dormancy **early** in January, however, and they could be grafted quite successfully thereafter. The scions were collected outside, had been subjected to periods of freezing before collection, and put out vigorous new growth after being grafted. This new procedure yielded much better grafts than the old method and allowed more latitude in time of grafting. It has now been adopted as standard procedure. Since scion collection in the middle of the winter, especially from tall trees, is often difficult, shooting them down with a shotgun was tried in January. This method proved quite spectacular and attracted some publicity, but the results did not seem promising. It was possible to obtain lots of scions from

tall trees in this manner, but most of these were rather small, yielding weak grafts that would require at least another year's growth to reach a size suitable for infection with blister rust. To overcome this disadvantage, early scion collection was tried in the fall of 1951. Scions were collected in late September and placed in beakers with water in a refrigerator at a temperature of slightly above freezing. In early November, when snow became available, the scions were placed in boxes with snow and stored at a temperature of about zero until grafting time in January. Another lot of scions was collected in early November and immediately stored in snow. The grafting results with the second lot of scions appear so encouraging the fall collection of scions and immediate storage in snow are likely to be more widely used. According to the method of outside grafting of white pine developed in 1948, the scions are collected in late March or early April and kept dormant in beakers with water in a refrigerator until new growth starts on the stocks outside, usually in late May, when they are grafted. In 1951, April collection of scions and immediate grafting were tried on a small scale. This new method was highly successful. It resulted in a much higher percentage of take and better growth of the scions than the older method. Since this new method also eliminates the somewhat cumbersome storage of scions in a refrigerator, to keep them dormant until grafting time, it appears well worth adopting in all outside grafting of white pine where long-distance transportation of scions is not necessary.

Poplar The accelerated propagation of poplar varieties of the cottonwood group for use by industries in southern Ontario was continued during the year under review. Cuttings of several new hybrids were again distributed for testing to the Ontario Paper Company for planting in their nursery at Gore Bay. A new poplar nursery was started by Howard Smith Paper Mills of Canada Ltd. in Cornwall and cuttings of several varieties were sent there for testing and propagation. The poplar plantation near Hanover, owned and operated by Knechtel's Ltd., received its first pruning.

Several new and quite promising cottonwood varieties and hybrids were seen during the International Poplar Congress in England and steps were taken to obtain cuttings of these, for testing under our conditions. Contacts were made with several poplar growers in Europe during that Congress and a greatly expanded exchange of poplar cuttings and breeding materials of other tree species is anticipated in the near future. A poplar breeding arboretum was established along lines similar to those seen in England, and a fairly representative collection of our most promising poplar varieties was assembled in this manner.

Much additional material of the aspen group was also assembled and tested for its breeding value. Branches from 4 silver poplars planted at the arboretum of the C.E.F. in Ottawa and from one large tree in Rochester, N.Y., were forced in the greenhouse and crossed with

largetooth aspen. The tree in Rochester and one of the Ottawa trees yielded very promising hybrid progenies, while the other 3 Ottawa trees yielded fair results. The two Chinese species P.adenopoda and P.tomentosa in Rochester were again used in breeding and preliminary results of their breeding value in several crosses are now at hand. Of these, P.adenopoda has yielded very promising hybrids with trembling aspen, while its hybrids with largetooth aspen thus far are rather slow-growing. Dr. Schreiner has already crossed this species with silver poplar and obtained rather mediocre results. The other Chinese species, P.tomentosa, gave very promising seedlings when crossed with largetooth aspen. Its hybrids with trembling aspen and with silver poplar, made previously at the Arnold Arboretum, are not very promising. Thus future breeding work with P.adenopoda offers most promise in crosses with trembling aspen, while P.tomentosa is most promising in crosses with largetooth aspen. Through Dr.Attwood contact was established with the Quetico-Superior Wilderness Research Center in northern Minnesota and a large collection of branches with flower buds and scions collected from selected trees of the two native aspens was received from there. This material was at once utilized for breeding and has yielded several promising hybrid progenies. A collection of branches from selected aspens in Finland was received from the Forest Research Institute in Helsinki. Although the flower buds did not stand the long-distance transportation and fell off soon after grafting, the material survived very well and will be suitable for breeding work in the near future. The same was the case with a collection of silver poplar branches received from the Union Allumettiete in Belgium. The latter contains some very vigorous types of silver poplar, quite distinct from the material usually grown in Canada. The results of rooting capacity tests of stem cuttings of some recently acquired silver poplar materials thus far indicate that several clones from England have about the same rooting capacity as silver poplars commonly planted in Canada. Continued tests, with much additional material, are under way. Some seedlings of silver poplar, of Hungarian origin and now in their third year, are showing remarkably good growth form, far superior to anything seen before in this species. A clone of P. alba x grandidentata derived from a tree of exceptionally good form near Toronto, has also shown very vigorous and straight growth in the nursery and is being propagated for further tests.

The results of various buddings of aspens on cottonwoods were rather discouraging. The material at first grew very well on rooted cottonwood cuttings but later the roots died. Surprisingly enough, silver poplar grafted on a willow took very well and showed good survival, although slow growth, at least during the first year. Further experiments in budding of aspens on various cottonwood and balsam poplar hybrids were continued, with the aim to find a suitable stock, with good rooting capacity and compatibility with aspens, on which to propagate aspens. A series of bench grafting experiments with the same materials was initiated in the fall and is being continued throughout the winter.

Induction of early flowering in aspens by means of grafting juvenile material into the crown of an early-flowering form of trembling aspen has now progressed so far that some of the top grafts are being used in breeding work.

Soil sterilization, as seen on the trip to Denmark, was used in raising some of the hybrid progenies obtained, and with quite spectacular results. After about a month's growth in sterilized soil, the seedlings are about 3 times as large as those raised in the same, but unsterilized soil.

Arboretum It has been mentioned that a small poplar collection was established in the arboretum. Because no additional land was available, no further expansions in the arboretum were made. A piece of heavy clay soil not suitable for growing pine, was kept fallow throughout the summer and will be used for further expansion of the poplar collection. Several of the Scotch pine and white pine in the arboretum were topgrafted with scions of selected clones, and with generally quite good results, in spite of the late season of grafting.

Other work The experiment in partial girdling of planted red pine in Vivian Forest was continued. The trees had an abundant crop of cones and a detailed tally was made of the cones on the girdled trees and the controls. The material was given a moderate shinning to allow for crown expansion and increased cone production in the future. The results of the tally give abundant evidence of the effectiveness of continued partial girdling as a means of increasing cone production in young plantations of red pine. A plantation of Japanese red pine (P.densiflora) was discovered at Midhurst in connection with an inventory after the hurricane there last summer. This plantation was thinned and the trees numbered for further study. It is planned to collect scions from all the trees and graft these on young Scotch pine at Maple, with the aim of using them as intermediate pieces in double grafts and thus, possibly, to increase cone production in young red pine in this manner also.

APPENDIX "C"

Division of Horticulture
Central Experimental Farm, Ottawa
A.W.S. Hunter
1951

Breeding for Resistance to Dutch Elm Disease

In continuation of the effort of the Division of Horticulture to produce elm hybrids that are resistant to Dutch elm disease, Ulmus americana and U. pumila were crossed resiprocally on a large scale in the field in the spring of 1951, but no seed was obtained. It is intended to make further attempts to hybridize these two species this spring, both in the field and on cut branches in the greenhouse. Improved greenhouse facilities in the nature of a small high humidity house are now available for the latter method.

It is possible to produce hybrids between the tetraploid U. americana and the diploid U. pumila as demonstrated by the single seedling obtained in 1949. It is also possible that such hybrids will carry the resistance of U. pumila to Dutch elm disease, although this remains to be demonstrated. However, the desirability of these hybrids as shade tree replacements for U. americana is far from assured, and it must be admitted that we hope that resistant trees of U. americana itself will be found as a result of the work at L'Assomption. If found, such trees can be propagated vegetatively for street and other ornamental planting. The reaction to Dutch elm disease of the seedlings of resistant trees, if found, will also be determined.

Another approach that is being investigated is the value under Canadian conditions of disease resistant European varieties such as Christine Buisman and Bea Schwarz. Two trees of the former variety are now in the nursery of the Division of Horticulture, and we expect to have scions of the other this spring.

Vegetative Propagation of American Elm

The work on the propagation of U. americana at the Dominion Experimental Station, L'Assomption, Quebec, is progressing favourably. The greenhouse that was built for this work is now in operation. A high rate of rooting (up to 92 per cent) was secured in 1951 following indolebutyric acid treatment of soft wood cuttings taken in late June. This station is now in a position to begin the propagation for testing, of elm trees which, growing in an area of high infection with Dutch elm disease, have themselves shown no symptoms of infection. This

station also has seedlings of such trees that are almost ready for inoculation to test their resistance to Dutch elm disease. Arrangements for this will be made shortly.

Sterile Ribes for Blister Rust Studies in White Pine

For the purpose of providing sterile Ribes plants that could be used by Dr. Heimburger as a source of inoculum for his blister rust studies with white pine, crosses were made at Ottawa in the spring of 1951 between black currants and red and white currants. The varieties used as parents were chosen for their high degree of susceptibility to rust. From 96 flowers pollinated, 42 fruits, containing apparently normal seeds, were harvested. The seed has been sown and should germinate this spring.

APPENDIX "D"

DUTCH ELM DISEASE

In 1951 in Quebec the survey for Dutch elm disease was confined to cities and towns which were willing to co-operate in such work, so that it is not possible to say if there was any extension of the diseased area. However, it is probable that the distribution of the disease in the Province did not change materially. Up until the end of 1951 approximately 9,000 infected trees have been found in Quebec.

In Ontario Dutch elm disease had been found in 13 counties up until the end of 1950. In 1951 infected trees were located in three additional counties, these being Lennox and Addington, York, and Kent. Since the disease was first found in Ontario in 1948 a total of 310 infected trees have been located. However, the only county in which the disease is present to any great extent is Essex where a total of 259 diseased trees have been found. In many of the other counties only one or a very few infected trees have been located. In 1951 Carleton and Leeds were the most easterly counties, and Kent and Essex the most westerly, in which the disease was found. In view of the large area covered by the survey it is, of course, practically certain that some infected trees have not been found.

An illustrated circular in which the most recent information in regard to the control of this disease is given was published by the Department of Agriculture at Ottawa during the year.

APPENDIX "E"

DISCUSSION ON MR. PLACE'S ARTICLE

"TREE BREEDING PROGRAM FOR CANADA"

by W.H. CRAM

First, I wish to compliment Mr. Place on the fine symposium he has made of the Tree Breeding subject. He has also presented some excellent suggestions worthy not only of consideration but worthy of adoption.

Secondly, I appreciate this opportunity of discussing the article with you.

- page 166:-re 'Improving the (potential) genetic quality of seed'.

"Restriction of cutting of stands in order to have a definite number of 'plus' trees as seeders" has merit, only if, the selection of the 'plus' trees is based on previous progeny tests. Selection of such seedtrees on the basis of phenotypical characters alone is not valid.

- page 167:-re 'Segregation and evaluation of inherently superior trees and races'.

Progeny tests with open-pollination seed should take precedence over graft plantations; in this way the latter becomes a natural and economical phase.

- page 167-8:-re 'breeding'

Genetic arboretums have a place only after the superior germ plasm has been identified. Exotic species should first be evaluated for their breeding value via compatibility studies, progeny and physiological tests.

- page 168:-re. 'First Steps'

If there is dire need for a tree breeding program for the Forest Industry of Canada, re-organization of the Forestry Branch along the necessary lines appears to be the first step. The time has arrived to look at the trees which make up the forest, and be prepared to support a long term (20 to 60 year) program. The training and experience of Foresters should be utilized in the form of technical assistance to the specialists. Each specialist should be restricted to one species and its related genera. The program would require

direction from the specialists and demand co-ordination by the authorities.

Provincial assistance could take the form of classification of stands, and the selection of superior seedtrees via progeny tests. The value of grading nursery stock is questioned. As yet, there is no proof that seedling vigor is associated with mature vigor, only with transplant survival. Such a procedure tends to distort progeny tests.

I submit there is no need to import specialists other than linguists and those experienced in vegetative propagation work. A few plant breeders, with the wholehearted co-operation of pathologists, entomologists and physiologists, are adequate. Sufficient highly trained men in these categories now exist in Canada to formulate and guide the necessary program. I base these statements on the fact that tree breeding is still in its infancy regardless of country. Sweden, Germany, and United States have made the greatest advances to date, but even even in these countries only the elementary aspects and initial steps of a plant breeding program have been adopted. Plant breeding is a science, the principles being the same, be the crop alfalfa or spruce. Special techniques applicable to trees may be readily and economically derived from the literature. It appears that Mr. Place's suggestion of a clearing house for information is an excellent one, expecially if it includes a competent linguist to translate foreign publications. Finally, may I suggest that Foresters as a group must be reminded that specialists are not necessarily mad fools. Instead specialists are individuals who know their particular fields as well as Foresters know theirs.

I trust I have stimulated, your thinking (and not your anger), sufficiently to bear the following suggested approach to the Tree Breeding problem. Essentially my proposal constitutes a "Division of Labours" (using the Piceae genera as an example project):-

1. Foresters - are the key men, in that their special training and knowledge of tree species, characters, ecology, sexual reproduction and lumber aspects are essential in a breeding program. Their specific tasks would involve:-
   a) visual selection and recording superior seedtrees in all existing stands across Canada (this to ensure genetic diversity);
   b) collection of open-pollination seed from these selections;
   c) conduction of progeny tests (with assistance of specialists);
   d) selection, recording of 'elites' via progeny test; and collection of scions for their propagation;
   e) establishment, care, and seed harvesting of superior seed orchards;
   f) evaluation of introductions, exotics and hybrids in their particular region.

2. Propagationalist - essentially a specialist job. His tasks to be: -
   a) determine stock-scion compatibilities of species and genera;
   b) selection of specific rootstocks - for earlier flowering, disease resistance, zones and regions of Canada;

c) propagation of elites for breeding and seed orchards.

3. Plant Breeders - essentially a specialist competent in the fields of genetics and statistical methods as well as specializing in plant breeding. Their specific tasks to involve:-
   a) compatibility of species within genera and inheritance of desirable characteristic;
   b) self-and cross-fertility of elites as if affects seed quality;
   c) progeny tests - statistical designs and interpretation of results;
   d) hybridization of elites to evaluate best combinations for seed orchards across Canada;
   e) hybridize elites, species, etc. - in search for disease and insect resistance plus other desirable characters.

4. Other Specialists - essential to increase precision and value of above workers, to save time and reduce losses.
   a) Pathologists - to evaluate disease reaction of elites, exotics, species, progenies; - inheritance of resistance;
   b) Entomologist - to determine insect reaction of same and possible resistance of hybrids.
   c) Physiologist - photoperiodisin and adaptation of introduction.

5. Fundamental Studies - over and above the program to evolve short-cuts, verify methods, etc.
   a) relationships - between juvenile and mature vigor, etc;
      - seed character - viability etc;
      - self-fertility of elites and progeny vigor;
   b) Greenhouse evaluation of exotics and introductions - photoperiodism -- adaptation in Canada.

The above is sketchy but I trust it adds food for thought. The number of projects should be limited to only one, two or three, at the most, of the more important tree species. Mr. Holst is now specializing in spruce, Dr. Heimburger in pine and poplar, myself in Caragana. Is there need for specialization in any other genera? If not, I am sure I speak for my Colleagues in Tree Breeding when I say, "Give us the tools (as above) to complete the job". Greenhouse, land, equipment, labourers, technicians and more technicians will do much to produce earlier results.

APPENDIX "F"

A TREE BREEDING PROGRAM FOR CANADA

I.C.M. Place

The Forestry Chronicle 27#2 June 1951

(Comments by John Walker)

This article by Mr. Place contains many valuable suggestions by which greater progress might be made towards solving some of the problems which exist in connection with Canada's future forests, particularly from the standpoint of Tree Breeding and Tree Improvement.

The remarks which follow do not constitute a critical review of Mr. Place's article. Rather, they are intended to focus attention on methods and personnel which might be employed to insure the most significant returns from efforts expended.

Appoint Special Committee

I would like to suggest, first that a committee be appointed by the sub-committee on Forest Tree Breeding to study and recommend a Tree Breeding Program for Canada in the light of Mr. Place's and other published articles and in keeping with objectives sought. For this committee I would recommend Drs. Cram, Heimburger, Hunter and Messrs. Holtz and Place. To this committee there might be added representation from industry, and other desirable organizations.

The report of this committee might include suggestions for:

1) the improvement in quality of tree seed for immediate regeneration needs.

2) a division of work among various services interested in tree improvement whereby unnecessary duplication of effort may be eliminated.

This might include suggestions:

a) as to priority of work to be undertaken.

b) for the development of tree seed nurseries.

c) reviews of literature.

d) desirable new projects.

This committee might carry on by correspondence throughout

the year, but the members should be authorized to meet and complete their recommendations by discussion the day before the Annual meeting of the sub-committee on Forest Tree Breeding.

Apart from farm tree planting in the prairie region of Canada two major considerations of a Tree Breeding program might be:

1) Improvement of the Forest.
2) Improvement of the Farm Woodlot.

Improvement of the Forest (Mostly Crown Lands)

In this project the main objective would seem to be the maintenance or improvement of the quality of trees through regeneration practices. Recommendations may be based on findings from experiments covering the following:

a) burning clear.
b) strip clearing - seed trees in adjacent strips.
c) scarifying forest floor and seeding from the air.

By adopting the most promising methods of retaining land in production of the most valuable species the problem of land becoming unproductive or producing species of little value, as mentioned by Place would seldom exist. Regeneration would be accomplished by seedling - the only practicable method in a forest.

Improvement of the Farm Woodlot: (Mostly Private Lands)

This project is characterized by intensive cultivation; a hand-labour, family proposition. Species grown are in greatest demand in, and most suitable for, the locality. Plants would be used to bring about regeneration.

To insure its development the new farm woodlot might be tax-free for the first ten years, and planting material might be supplied by government agencies. (This would include improved and hybrid types of plants.)

Tree Breeding and Improvement:

Preliminary work by Heimburger, Cram and others indicate that improved tree types are assured through breeding. Nursery propagation methods are also being perfected. Of necessity, the program must be directed by government authorities but financial support from commerce on a scholarship or project basis should be sought. Meantime a supply of superior seed could be built up for seeding for future generations of trees, because the viability of most

conifer seeds is retained for years.

Outline of Breeding Program:

a) Evaluate seedtrees by progeny tests i.e. by open pollination seed. (Already being done at the Forest Nursery Station with Scots pine)
b) Cross best parents from tests in a) above in seed plots to produce superior seed in bulk.
c) Produce new seed trees and hybrids by breeding and selection.

Just as "plus" stands must be proven as suitable sources of seed, so also must seed trees in the above outline be proven. To find this proof is a long-term project, i.e. correlation of seedling characters with mature characters.

For the present, and until definite tree seed nurseries can be established at desirable and convenient locations, governments might exercise strict supervision of seed collections used for regeneration seeding. Assistance might also be desirable for the purchase of specialized seed collecting equipment.

Improved poplar types which, when once established, can reproduce by root sucker growth, are assured through the efforts of Dr. Heimburger. Commercial means of multiplying these for use in reforestation appear to be bright. Plans to capitalize on these improved types for the benefit of the wide community should be undertaken by personnel with the necessary authority and facilities. The use of improved types for planting would be in line with improved mechanics of lumbering, etc. Tree crops could also be produced on more accessible land. Better trees would compensate for higher operating costs, etc.

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