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NATIONAL RESEARCH COUNCIL OF CANADA

PROCEEDINGS

OF THE

THIRD MEETING

OF THE

SUBCOMMITTEE ON FOREST TREE BREEDING

OTTAWA

25 APRIL, 1940

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P R O C E E D I N G S

of the

Third Meeting

of the

SUBCOMMITTEE ON FOREST TREE BREEDING

Held at the National Research Laboratories, Ottawa.
25 April, 1940

Present:

Members:
Dr. R. Newton (chairman)
Mr. C. E. Atwood
Mr. D. Roy Cameron
Dr. N. H. Grace
Dr. C. Heimburger
Dr. L. P. V. Johnson
Mr. C. G. Riley
Mr. W. M. Robertson
Dr. H. A. Senn
Dr. F. H. Peto (secretary)

Visitors:
Mr. J. L. Farrar
Dr. J. G. Malloch
Mr. A. W. McCallum
Mr. A. Skolko

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39. Minutes

The minutes of the second meeting of the Subcommittee on Forest Tree Breeding were read and approved with the following changes suggested by Mr. Riley. Minute 22, (b) "rust free" to replace "resistant"; Minute 29, paragraph 3, "Septoria" to replace "septorial"; Minute 29, paragraph 3, "diseased" to replace "susceptible".

40. Project Organization

Dr. Heimburger discussed the advisability of modifying the project outline to bring it in line with that in use in the United States. Dr. Heimburger's suggestions are incorporated in Appendix A.

Dr. Johnson considered that the matter of project outline should be given further consideration. He explained that Section E (Reforestation and Afforestation) was included for the sake of completeness.

The chairman suggested that further deliberations on this matter should be left to the special subcommittee originally appointed for this purpose.

41. Report of progress and plans in forest-tree breeding

In outlining the progress of forest-tree breeding during the winter, Dr. Johnson dealt briefly with the following studies:

1. The relation of growth rate to specific gravity, fibre characteristics, and pulping qualities of the wood in hybrid poplars. (See Appendix A)

2. Damping-off control in pine and spruce grown in the greenhouse under controlled conditions of temperature, humidity and soil moisture. Of several chemical treatments, a 1 - 400 suspension of Semesan in water was found to give the best control.

3. Germination of dormant basswood seeds. Attention is being given to the improving of existing methods (which have serious disadvantages) and one very promising lead is being studied.

4. Artificial germination of pine and poplar pollen. A medium of 5.0% sucrose in 0.75% agar was found best for poplar pollen. This concentration was the best of the sugar media for pine pollen also, but was not significantly superior to a distilled water medium.

5. The effect of nutrient solutions on the development of detached flower branches of *Populus grandidentata*. None of the concentrations of Hoagland's solution, sucrose solution nor combinations of the two was superior to the distilled water check.

6. Colchicine treatments of forest-tree seeds was applied to some twenty-five species involving ten genera. The characteristic preliminary effects of chromosome doubling appeared in all species.

7. The effect of humidity on longevity of poplar seed. The best result was in the case of P. grandidentata stored at 20% humidity, which still gave 3% germination after 555 days.

8. Greenhouse hybridization of Populus species was continued. The most promising new cross is P. berolinensis x Northwest poplar, the latter species being resistant to Septoria canker.

With respect to the breeding work during the coming season, Dr. Johnson proposed the following additions to the existing program:

1. The extension of hybridization work to include maple, oak and ash, providing such work does not interfere with essential work on more important genera. It was pointed out that in the planted woodlot it was quite possible that species not commercially important in the exploitation of virgin stands might prove to be the most profitable to the grower.

2. Studies on genetical and environmental characters in seed trees. The work of the Ontario Forestry Branch at Timagami, in which seed trees are being left in the cutting of extensive virgin white pine stands, was cited as a prospective field for these studies. A related study would involve the effect of inbreeding in isolated seed trees of monoecious species, e. g., white pine.

3. General plans for the development of an experimental area at the Annex were outlined; but, in view of uncertainties arising from the war, the matter could not be considered as being in immediate prospect.

Attention was drawn to the following publications relating to forest-tree breeding:

Johnson, L. P. V.
The breeding of forest trees. Forestry Chron. 139-151. 1939.

Johnson, L. P. V.
A descriptive list of natural and artificial interspecific hybrids in North American forest-tree genera. Can. J. Research, C, 17:411-444. 1939.

Mr. Riley pointed out that Northwest poplar is not immune to Septoria canker but may be more resistant than most other species. Dr. Heimburger stated that Northwest poplar is believed to be a single clone of P. jackii.

The importance of spruce breeding and poplar breeding for the prairie provinces was emphasized by Dr. Heimburger.

Mr. Robertson drew attention to the need for the selection of superior types of balsam for the Christmas tree trade but Dr. Heimburger suggested that this problem was only of secondary importance.

Dr. Johnson admitted the great importance of spruce breeding but suggested that certain other species may prove to be of more value than spruce under woodlot and plantation conditions.

The secretary pointed out the danger of evaluating breeding possibilities in any species for woodlot productions on its value for exploitation in natural stands. The economic advantages of rapid growth might outweigh advantage in quality of slower-growing species.

42. Vegetative propagation

Work in progress.

Work during the past winter has been confined to white spruce, Norway spruce, white pine, canescens poplar, trembling aspen, and basswood. Season of collection and treatment with hormonized dusts continue to be the main features being investigated. A new idea is the storing of winter collecti[illegible] of cuttings outdoors for spring planting. Further work on media and watering with nutrients is being done with Norway spruce cuttings. Stoutemyer's precallusing technique with hardwoods is being tried with the poplars and basswood. Exploratory experiments with various dusts have been carried out on these species.

The animal rooms on the fourth floor of the National Research Laboratories are unsuited to growing conifer cuttings for the following reasons:

The ventilation is poor, the air is dry, and chemical fumes are often present. Zinc in the tap water also caused considerable trouble but this has been remedied by the use of distilled water.

Plans for summer work at the Petawawa Forest Experiment Station.

Experiments now in progress will require much of the time available during the coming spring and summer. This will include planting the cuttings now heeled in at the National Research Laboratories, taking notes on new growth and mortality on these and on the experiments put in during the summer and fall of 1939. This spring final notes on root development will be taken on the experiments put in by Dr. Grace in the spring of 1939, and in the fall the same will be done for the later experiments of 1939.

New work in the spring will consist of two or three collections of Norway spruce to complete the series begun in 1939, lining out rooted cuttings for observation on their growth, and potting of seedling transplants for experiments on grafting. In mid-summer some collections of hardwoods will be tried. The most of the new work will be done in the fall, the time of year that past experience has indicated to be the most favourable.

Publications

There follows a list of papers published to date dealing with the vegetative propagation of forest trees. In addition a paper is now in the course of preparation based on Investigation IV-A-38-G1, and another on a group of six experiments.

Grace, N. H. Vegetative propagation of conifers.

I Rooting of cuttings taken from the upper and lower regions of a Norway spruce tree. Can. J. Research, C, 17:178-180. 1939.

II. Effects of nutrient solution and phytohormone dusts on the rooting of Norway spruce cuttings. Can. J. Research, C, 17:312-316. 1939.

III. Effect of month of collection on the rooting of dormant Norway spruce cuttings. Can. J. Research, C, 17:376-379. 1939.

IV. Effects of cane sugar, ethyl mercuric phosphate, and indolylacetic acid in talc dust on the rooting of Norway spruce. Can. J. Research, C, 18:13-17. 1940.

V. The effect of indolylacetic acid and nutrient solutions on the rooting of Norway spruce cuttings. Can. J. Research, C, 18: 122-128. 1940.

Deuber, C. G. and Farrar, J. L.

Rooting Norway spruce cuttings without chemical treatment. Science 90:109-110. 1939.

Rooting Norway spruce cuttings. American Nurseryman 70 (4):3-5. 1939.

Farrar, J. L.

Rooting of Norway spruce cuttings. Forestry Chron. 15:152-163. 1939.

Dr. Heimburger reported on certain experiments on propagation. A summary of this work is to be found in Appendix B. During further discussion of the propagation studies, he particularly emphasized the importance of further research on the influence of various horticultural practices on rooting of stem and root cuttings.

43. Forest Pathology

Mr. Riley presented a summary of work proposed for 1940 which is found in Appendix C.

The secretary stated that the white pine blister rust disease garden will be started at the Annex in the spring of 1940. Both the Ribes plants and certain white pine seedlings will be planted there this spring by Dr. Johnson.

44.
Nursery development at the Annex

The secretary described the rather extensive plans for the development of the nursery at the Annex this year. However, the uncertainty of obtaining the appropriations asked for in the main and supplementary estimates of this committee will probably result in a marked curtailment of this development.

Dr. Senn stated that if the cuts in appropriations made it impossible to grow all of the valuable breeding material, he felt sure that the Division of Botany might be able to grow some of it for us.

45.
Test area at the Annex

Dr. Johnson discussed the plans for development of a regional test area at the Annex. He explained that this development was to quite an extent dependent on whether a unit of the N. F. P. would be able to assist with the large amount of manual labour necessary. Since these units may not be operating this year he felt that immediate development of this area was probably not possible.

46.
Wood quality tests

Dr. Johnson reported on the tests conducted by himself and also at the Pulp and Paper Research Laboratory in Montreal. The reports are given in Appendix D.

47.
Cytogenetic studies

The secretary reported that he had continued his heat and cold treatments of poplar catkins with the object of producing triploid and tetraploid poplar hybrids.

A large proportion of giant pollen grains were obtained in certain treatments. This pollen was used in crosses and the resulting plants will be examined cytologically to detect polyploid plants.

Dr. Heimburger suggested that decapitation and callusing with indolylacetic acid should be tried since it has been particularly successful in producing polyploid tobacco plants.

48. Statement of Arboretum requirements

Dr. Heimburger summarized a statement he had prepared on arboretum requirements. This statement is included as Appendix E.

49. Visit to Institute of Forest Genetics, Placerville, California

An interesting description of this institute was given by Dr. Heimburger who visited there during the winter.

50. Summer meeting

It was agreed to hold a summer meeting at Petawawa, the date to be arranged by the secretary on consultation with the members.

The meeting adjourned at 12:30 p.m.

APPENDIX "A"

(Dr. C. Heimburger)

Project Outline

This outline is dynamic, not static, although the main framework is relatively permanent. It consists of two parts - original framework - i. e., project classes and statement of individual projects under way, planned for more or less immediate future, and projects terminated. Our present outline is a combination of these two parts, which is a drawback. Therefore a revision is needed. Another reason for revision: The project outline under discussion was drawn up by the Lake States Forest Experiment Station in co-operation with the Division of Biology and Agriculture of National Research Council of United States and recently adapted by the Dominion Forest Service of Canada. Similarity of main framework would be of great advantage for present and future co-operation and exchange of information.

The United States outline is as follows:

FOREST BOTANY
- Taxonomy
- Anatomy and Morphology
- Physiology
- Phenology
- Genetics
  - Source of seed
  - Tree Breeding

This Subcommittee is concerned chiefly with Genetics in its broad sense and it is therefore suggested that the projects be grouped according to the following main framework:

Genetics
- Source of material
- Breeding, with the other phases having an equal rank

In respect to organization the project outline of 6 April, 1939, is far superior to the outline of 28 November 1939, which is deplorable. We should advance in this respect, not retrograde into complicated impractical rigidity.

General Outline

- Forest Botany
  - Genetics
    - Source of material
    - Breeding
    - Cytogenetics
    - Wood technology
    - Vegetative propagation
    - Pathology
    - Zoology
    - General

Source of Material

Selection of native types, in natural stands, in artificial stands.

Selection of exotic types, in natural stands, in artificial stands.

Testing of:	biotypes	in:	laboratory
	select types		seed bed
	clones		propagation frame
	one-parent progenies		greenhouse
			transplant row
			test (plantation) stand

Breeding

Controlled pollination
Phenology
Pollination technique
Fruit protection
Fruit harvesting
Seed extraction
Seed quality tests
Tests of hybrid material obtained in: laboratory seed bed, propagation frame, greenhouse, transplant row, test-stand
Compatibility
Dichogamy
Study of character inheritance
Correlation of juvenile with mature characters
Comparison of hybrids with equivalent parent material

Cytogenetics

Histology
Mitosis
Meiosis
Fertilization studies
Production of polyploid forms by: temperature, radiation, chemical agents

Unreduced sexual cells
Polyploid somatic cells

Artificial mutant production by: temperature, radiation, chemical agents

Wood Technology

Anatomy
Mechanics
Chemistry (including tanbark)
Correlation of juvenile to mature wood characters
Comparison of offspring with parents

Vegetative propagation

Stands as it is 28 November, 1939. Grafting may be amplified using stem or root cuttings as example.

Pathology

Non-parasitic diseases
Parasitic diseases

Observation of diseases in: seed beds, transplant rows, stands

Artificial inoculation in: seed beds, transplant rows, stands

Zoology

Game	Observation of influence in: (as pathology)
Vermin	
Domestic animals	Artificial infection (subjection to influences by-) in: (as in pathology)
Man	
Insects	
Mites	

General

Administration
Co-operation
Equipment and Facilities
Reports
Publications
Exchange of information
Distribution of produced material
Application of produced material - advisory activities co-ordination.

APPENDIX "B"

(Dr. C. Heimburger)

Experiments with aspen poplar roots during the winter 1939-40

Propagation by means of root cuttings so far appears the only practical method for aspen poplars and their hybrids, and will have to be used until a fully satisfactory method of propagating this material by means of stem cuttings is found. Therefore basic research on the behaviour of aspen roots, leading towards the development of improved methods of propagation by means of root cuttings is justified. Some observations of this kind were made by me in the laboratory during the winter of 1939-40. Roots of young seedlings of trembling aspen (Populus tremuloides) were dug out in a gravel pit near Pensive Depot of the Gatineau Division of the Canadian International Paper Company in September, one single root about 18 inches long being taken from each seedling. The roots were bundled and kept in moist sawdust in a refrigerator until their use in the laboratory during the winter. In the winter, each root was cut into sections about 2 inches long and forced on moist filter paper in Petri dishes. During November and December the roots were largely dormant and did not react to forcing except a few of the distal sections of some of the roots. In January and February the dormancy gradually disappeared and it became possible to force an increasing proportion of the sections, the more distal sections, however, responding more rapidly to forcing than the proximal sections. During the latter part of the winter it was possible to force all sections of the roots, even the most proximal sections responding quite readily to forcing. Some roots were, however, quite inactive in this respect even very late in the winter, and great individual variation in respect to reaction to forcing could be observed. As a rule the root sections first started to produce shoots near their proximal ends and shoot production started much earlier in the winter than root production from the distal ends of the sections. All root sections showed a very distinct polarity in their root and shoot production. In respect to root production the sections of each individual root behaved in a very similar way, i.e., certain roots produced abundant roots from the distal ends of their sections, others produced only a few weak roots from all their sections, and some did not produce any roots at all, even if shoot production was quite pronounced at the proximal ends of the sections. Thus, it seems as if there is great individual variation in shoot as well as in

root production by root sections taken from different seedlings. This cannot but greatly influence the propagability of the seedlings in question when grown under nursery conditions.

The sections showing good shoot and root production were placed in perforated corks in Erlenmeyer flasks with their roots immersed in Knop's solution with soil extract. The resulting plants grew quite well, if the solution was changed weekly. The shoots of some section groups soon produced healthy dark leaves and grew quite rapidly. The roots developed side-roots and grew to a considerable length in some cases. Also in this respect there was considerable individual variation in the extent of the root system produced by sections taken from different roots. Some groups of sections taken from individual roots produced only fair to poor root systems in the nutrient solution, and did not improve even after 1-1/2 months of growth. A few section groups only produced a single weakly developed root which branched out in a dense brush of thin side-roots and remained in this stage for the rest of the winter.

A series of experiments in cutting off the newly formed roots of the sections growing in nutrient solution was then made. Some section groups showed a marked capacity of root regeneration, irrespective of the size (thickness) of the sections, while other section groups showed moderate to poor regeneration capacity. The growth and especially the root regeneration capacity of the sections was improved by the addition of yeast extract to the nutrient solution in which they were growing. The reaction is possibly due to the content of vitamin B1 in the yeast extract. In this respect the section groups showing the greatest root regeneration capacity responded more markedly to the addition of yeast extract than the section groups showing poor or no root regeneration capacity. Root regeneration capacity thus in essence corresponds to rooting capacity of stem cuttings and is a good index of propagability of this material. Aspen poplar belongs to the group of plants reacting favourably to the application of yeast extract, either because of its content of vitamin B1 or of another substance beneficial to their growth. Towards the end of the winter some of the newly formed roots reached the thickness of the original sections and an attempt was made to cut these into sections, to place them on moist filter paper in Petri dishes and to produce new plants from them. All these attempts failed, however, It seems that a root section has to be dormant before it is forced or that the sections produced in nutrient solution are not equivalent to the sections obtained from roots growing in nature at the end of a summer. The following conclusions can be drawn from these observations:

The pronounced polarity of the root sections allows the planting of horizontal root cuttings in the nursery, the proximal ends of the cuttings producing shoots and the distal ends producing roots. This is far more simple than the usual method of oblique or vertical planting of root cuttings usually practised in nurseries. The pronounced dormancy of the roots during the early part of the winter makes it possible to ship root cuttings without the danger of sprouting during transportation. The response of the material to yeast extract opens the possibility of treating weak aspen seedlings or growing young plants, as well as flowering branches used in crossing, with yeast extract to improve their growth so as to overcome the critical seedling stage during which the seedlings are subject to excessive damping off, and on the other hand, to improve the seed setting of cut branches used in crossing according to the method of Wettstein. The ability of root formation, the kind of root systems formed, and the ability of root regeneration, are three characters influencing propagability of the material from root cuttings. In respect to all three factors there appears to be individual variation which is most probably inherent. This opens the possibility of testing the material for rooting capacity from root cuttings in the laboratory which is far simpler and quicker than routine nursery tests. The statement made by several nurserymen that root cuttings should be dormant when made and planted is confirmed by these experiments.

APPENDIX "C"

(C. G. Riley)

Summary of work proposed for 1940

Heartwood decay in poplar

In order to determine the degree of susceptibility of poplar and other kinds of trees to heart rot, it is desirable to develop a shorter method than to wait till the trees reach the age of normal heartwood development, before making the tests. Experiments are under way to determine if younger trees can be used for this purpose. Some success has been attained in infecting 3-year-old poplar. A number of inoculations made in 1939 on 10-year-old poplar will be examined this year, and additional experiments along similar lines will be undertaken.

Rust of poplars

(a) Studies to determine if more than one kind of rust involved, and identification. It is important to know if we are dealing with the eastern or western species, or both. The study involves: (1) A search for the aecial stage on possible alternate hosts. (2) Inoculation experiments on possible alternate hosts, using overwintered teliospores. (3) Inoculation experiments on poplars using aeciospores, if these can be found or produced artificially. (4) A search for possible overwintering on poplar.

(b) Determination of degree of susceptibility or resistance of poplars in nurseries: (1) By observations on natural infections. (2) By means of artificially controlled inoculations.

Napicladium die-back of poplar

Indications are that this disease can become serious, though instances of this are not common at Petawawa. Studies planned for this year, involve: (1) Search for, and studies of the overwintering stage and primary infections, in the nursery and in the woods. (2) Inoculation experiments for purpose of studying early symptoms and for testing trees for degree of susceptibility.

Septoria, Hypoxylon, and Cytospora cankers of poplar

Preliminary inoculation tests will be made on such trees as may be ready, for determination of degree of susceptibility or resistance to these diseases.

Poplar test plot

The experiment station authorities have agreed to set aside a portion of the Russian poplar plantation on Meridian Road, to be used as a test plot. Septoria canker is very prevalent on these trees. It is planned to plant out samples of experimental breeding stock on this plot so that they will be subjected to severe conditions favouring natural infection, as part of the test to determine degree of resistance to this disease. Similar test plots may be established for other diseases, or these may be combined.

Blister rust of white pine

Inoculations will be made in order to develop technique, and become familiar with the early symptoms, in preparation for testing experimental breeding stock when such becomes available.

APPENDIX "D"

(Dr. L. P. V. Johnson)

Studies on the relation of growth rate to wood quality

1. Report of pulping tests on Populus grandidentata and P. alba x P. grandidentata

An entire trunk (AG-106) representative of the more vigorous P. alba x P. grandidentata hybrids, and a similar trunk (G-2) representing the average P. grandidentata type, were sent last fall to the Pulp and Paper Division, Forest Products Laboratory, Montreal, for tests of pulp quality (Prog. Rept. 18/39). Reports on these tests received from Montreal are summarized and discussed in the following sections.

(a) Description of material

The tree from which sample G-2 was collected was an ordinary P. grandidentata and may be considered as parental, or check, material. It grew relatively slowly, being about 18 years of age, 40 feet in height and 3.9 inches in diameter at 18 inches from the ground.

The tree from which sample AG-106 was collected was a representative hybrid of P. alba x P. grandidentata which grew near G-2 but under conditions of less competition. It grew rapidly, being six years old, 34 feet in height and 5.0 inches in diameter at 18 inches from the ground.

It is considered that since these two samples differed so greatly in growth rate, the tests should indicate whether any marked peculiarities in pulping quality might be expected in wood derived from abnormally rapid-growing hybrids.

(b) Chemical analysis

Wood analysis shows nothing of interest except that specimen AG-106 is slightly higher in lignin and somewhat lower in cellulose than is G-2.

(c) Screen classification of fibre

Fibre length of G-2 is similar to that of aspen soda pulp now on the market. In AG-106 the proportion of 48-mesh unbeaten fibre is smaller (i.e., fibres are longer and less pass through the screen). Average diameter of unbeaten fibre is 0.020 mm. for G-2 and 0.022 mm. for AG-106.

(d) Pulp (soda) and paper tests

"The pulps are only slightly inferior to commercial soda pulp as regards printing opacity at the start of beating, but lose their opacity rapidly when beaten.

"Both pulps are inferior to the dried commercial pulp in bulk, AG-106 in particular giving dense sheets. Drying increases the bulk considerably, but AG-106 is definitely less bulky in the dried condition than G-2.

"The bursting,tearing and tensile strengths of the laboratory pulps are somewhat higher than normal for this type of pulp.

"Pulping of the two woods was repeated on a small scale with slightly different cooking conditions as a check. Tests of the pulp confirm tree AG-106 gives stronger but less bulky pulp than G-2."

(e) General Discussion

For soda pulp, AG-106 appears to have one main peculiarity which might cause discrimination against it - that is, the associated condition of being stronger and less bulky. The shorter, weaker fibres and bulky pulp give the desired formation and printing quality to some of the more important soda pulp papers. It is possible that soda pulp from trees such as AG-106 might not meet the standards demanded for these papers.

We must not forget, however, that the larger part of hybrid poplar wood grown in most sections of Eastern Canada will be utilized for sulphite rather than soda pulp - and that in the sulphite process a longer, stronger fibre than that of ordinary poplar is desired. We can state, upon the authority of officials of the E. B. Eddy Co., that the proportion of poplar that may be used in sulphite pulp is determined by degree of weakening occasioned by the weaker poplar fibres; and that, if a hybrid poplar had a longer, stronger fibre, a correspondingly larger proportion of poplar wood could be used.