# HARDWOOD TREE IMPROVEMENT AT PETAWAWA NATIONAL FORESTRY INSTITUTE

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ABSTRACT--Research on hardwood tree improvement has been conducted at P.N.F.I. for many years, but a new research program has been developed following the decision, in 1974, to increase the attention given to hardwoods. Results are presented of earlier work that demonstrated apparent variation in the susceptibility to sapsucker injury of some introduced and native birches. The new program has concentrated on Juglans nigra L., Fraxinus americana L., and Fraxinus pennsylvanica Marsh. Reasons for this choice of species, and the work done are discussed.

Hardwood tree improvement undertaken by the Canadian Forestry Service at the Petawawa National Forestry Institute (formerly the Petawawa Forest Experiment Station) has, until recently, had a relatively low profile in contrast to the well-known programs in spruces and hard pines. Moreover, much of the early work on hardwoods consisted of pilot projects which have not been widely publicized. A strong resurgence of interest in management of hardwoods in the 1970's led to the decision to appoint a hardwood tree breeder at Petawawa (Morgenstern 1974). This position was filled initially by Mr. R.F. Calvert, and all of the recent work that I shall describe was actually initiated by him before I joined the staff in June of this year.

## EARLY WORK - 1935 TO 1974

Work on hardwood tree breeding at Petawawa goes back at least to 1935 when Dr. Carl Heimburger initiated poplar breeding in Ontario (Zsuffa 1978). However, this work on poplars was not continued at Petawawa and, in Ontario, is mainly done by the Ontario Ministry of Natural Resources.

Interest in birch was also high in these early years, and both Carl Heimburger and, later, Mark Hoist obtained and grew seed of non-Canadian and native birches. One test, including the North American species Betula papyrifera Marsh, and B. populifolia Marsh., the European species B. pendula Roth. and B. pubescens Ehrh., the East Asian species B. japonica Winkl., and the hybrids B. pendula x papyrifera,

B. pubescens x papyrifera, and B. pendula x pubescens, was planted at Petawawa in 1948 and 1949. High post-planting losses of B. papyrifera virtually eliminated that species from the test, but a much higher proportion of the others survived and, by 1961, had reached heights of from 4.5 to 7.6 m and diameters of 7.5 to 15 cm. However, it was also found in 1961 that the plantation was suffering extensive damage from yellow bellied sapsuckers (Sphyrapicus varius L.); by 1967 destruction of the introduced non-hybrid birches was virtually complete (Viidik and Morgenstern 1970). Without exception all subsequent plantations of introduced birches have suffered severe sapsucker damage. The results presented by Viidik and Morgenstern also suggested that some of the birches were less susceptible to sapsucker attack than others, the hybrid B. pendula x pubescens being the least damaged. Brief inspection of this plantation in 1980 showed that several, but not all, of these particular hybrids had remained relatively free from injury. Possible seed-source related variation in the incidence of sapsucker injury has been observed in a plantation of B. papyrifera established at Petawawa in 1966 and 1967 using the Canada-wide seed collections made by Dr. W.H. Brittain of the Morgan Arboretum in Montreal. These observations raise interesting questions about variation in susceptibility to sapsucker injury, but answers to those questions will have to await a full evaluation of the plantations.

Other hardwoods are to be found in some of the older plantations and arboreta associated with P.N.F.I., but these are generally unreplicated tests containing small numbers of trees. Here, again, one very obvious result has been the severe sapsucker injury suffered by Alnus glutinosa (L.) Gaertn.

## RECENT WORK - 1974 TO PRESENT

Since its inception in 1974 the objective has been to develop the hardwood tree improvement program in response to the recognized needs and improvement possibilities. An equally important concern has been the availability of feasible silvicultural techniques for the establishment and management of plantations for either research or wood production purposes. Species considered for inclusion in the program were rated using a "chance of success index" developed and partly described by Calvert (1978), and which reflects views previously expressed by Schreiner (1962) and Farmer (1973). In this instance the intent of the index was to favor those species which presented no major obstacles to their improvement and use, and which would be well received by industrial users. Each species was rated according to the 10 criteria listed in Table 1, a favorable rating earning one point. The "chance of success index" was the sum of the scores. Some of the criteria do appear more important than others, but no weights were assigned to the criteria used as it was felt that this would have been done on a largely arbitrary basis. The three species receiving the highest ratings were Juglans nigra L. (8 points), Fraxinus americana L. (7 points), and Fraxinus pennsylvanica Marsh. (8 points). All three were rated unfavorably in terms of their rather specific soil requirements. Points were also lost on the basis of:

Table 1. Required conditions for favorable rating of criteria used in compilation of chance of success index.

| | CRITERION | CONDITION FOR FAVORABLE RATING |
|---|---|---|
| 1. | Seedling production | Large numbers of seedlings grown in nurseries |
| 2. | Plantation establishment | Satisfactory techniques available |
| 3. | Soil requirements | Adaptable to wide range of soils |
| 4. | Wood utilization | More than one use |
| 5. | Relative wood value | High value |
| 6. | Age of first flowering | Flowering by age 10 years |
| 7. | Seed Supply | Annual seed crops or satisfactory storage of less frequent crops |
| 8. | Artificial pollination | Relatively easily done |
| 9. | Vegetative propagation | Relatively easily done |
| 10. | Insects and disease | Relatively free from serious problems |

long time till flowering (F. americana), lack of significant nursery stock production (F. pennsylvanica), and use of wood for lumber and veneer only (F. americana and J. nigra). As a result of the ratings obtained in this analysis work on these three species has begun in cooperation with other workers in Canada and the U.S.A.

A common objective of all of the studies initiated has been the acquisition of basic genetic information on variation between and within stands throughout the range of each species in Canada. Replicated progeny and provenance test have either been established, or there are plans for their establishment as outlined below for each species.

Juglans nigra seed were collected.in 1977 from single trees throughout its Canadian range. Since the species occurred singly, or in groups of 2 to 10 trees, collections were made from the best phenotype in a given area. Germination in the nursery was poor but experimental plantations of different size have been established at 5 locations in Southeastern Ontario, using 5 replicates in a randomized block design and, in most cases, five-tree row plots per family. Seedlings were also sent to cooperators in Quebec and Wisconsin. No information is yet available on survival and early growth in these plantations.

Fraxinus americana seed were collected in the fall of 1977 and 1978 from 1 to 6 trees in each of 62 stands of white ash in Ontario, Quebec, and the Maritime provinces. Poor germination and slow growth in the nursery have limited plantation establishment in 1980 to a progeny test involving 148 open pollinated families from 50 different stands. Three additional test plantations are scheduled for establishment in Ontario in 1981.

Fraxinus pennsylvanica seed collections have been made since 1977 with the objective of establishing progeny and provenance tests. Additional collections required to give the range-wide coverage wanted should be completed this year.

This account presents no more than a brief overview of work being done at P.N.F.I. but it does confirm that progress is being made towards meeting the commitment to develop and maintain an active program of hardwood tree improvement.

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