Fundy Model Forest

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Author: J. Loo

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Principal contact information: Atlantic Forestry Center, Canadian Forest Service
Natural Resources Canada
Phone: 506-452-3398

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The Fundy Model Forest…
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"The Fundy Model Forest (FMF) is a partnership of 38 organizations that are promoting sustainable forest management practices in the Acadian Forest region."

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American Beech Vegetative Propagation and Genetic Resistance Testing
End of Year Report, April 2004
Judy Loo

American beech has been an important component of late-successional hardwood and mixed-wood forests of eastern North America. Seed and buds are important sources of food for a number of wildlife species. During the past century, almost all beech trees in the northeastern portion of the species range have been severely damaged or killed by beech bark disease. However the northward spread of the disease has been limited by cold climate. With global warming, the diseased beech appears to be spreading further throughout the Maritime provinces and northward in Quebec, exacerbating already severe problems. We are conducting a research program aimed at developing the capacity for managing forest types having a component of beech by producing disease-resistant beech trees. Present forestry practices are moving toward eliminating the species from their natural ecosystems. Our long-term strategy to develop and introduce disease-free trees has the potential of maintaining the species presence in its natural range, while also enabling commercial utilization.

Though, vegetative propagation of American beech has proven very difficult, we are working to develop dependable methods for vegetative propagation of disease-resistant beech. We are also studying the mechanisms of resistance and its mode of inheritance. These steps are necessary in establishing a dependable long-term source of disease-resistant beech for restoration of tolerant hardwood forest.

For the past several years, seed has been collected and stored in the National Tree Seed Centre for growing rootstock from diseased and disease-free trees. Locations of more than 30 disease-free beech trees in southern and central New Brunswick, including several in Fundy National Park, have been documented. In summer 2002, seedlings were grown in the Canadian Forest Service greenhouse for use as rootstock in 2003. Scions were collected in spring, 2003, from 20 identified disease-free trees as well as 5 diseased trees, for grafting (Fig.1). At the same time, at least 200 buds were collected from each tree for micropropagation. All material for propagation was collected from the lower part of the crown to maximize juvenility. In late spring, branches (approximately 2 cm in diameter) were collected from a subsample of 10 disease-free trees for induction of epicormic shoots; and roots (1 – 3 cm in diameter) were collected for production of suckers.

Grafting:
Scions collected from disease-free and diseased trees were grafted onto wild rootstock (650 plants) in the spring of 2003 using standard top-cleft grafting techniques, wrapping the juncture with elastic bands and sealing with grafting wax. Grafts were maintained in a greenhouse under a watering and misting regime designed for grafted hardwood species. About one-third of the grafts were successful (Fig.2). There was high variability between genotypes and in general, the smaller the graft diameter, the lower the success (Fig. 3).

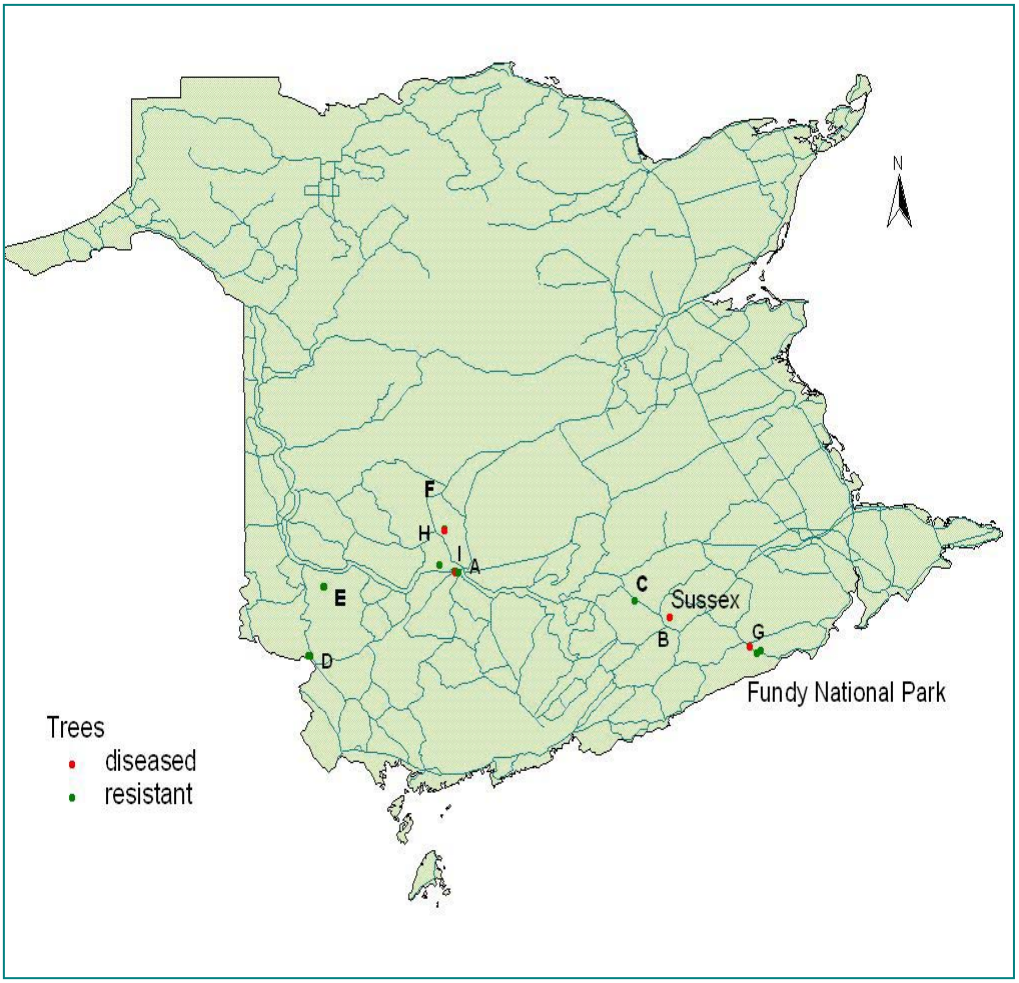

Figure 1. Location of 20 disease-free and 5 diseased beech trees samples for grafting and resistance screening experiment.

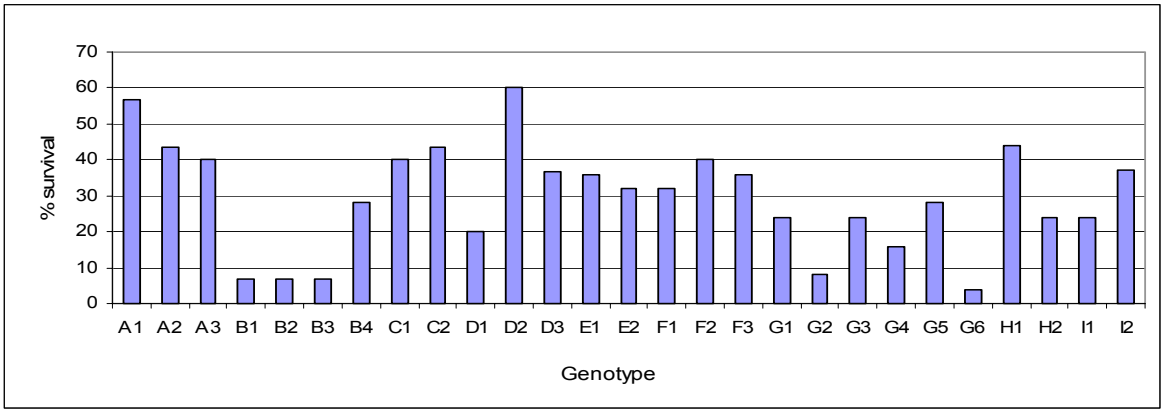

Figure 2. Grafting success by location (indicated by letters: A, B, C…) and by tree (number 1, 2, 3…).

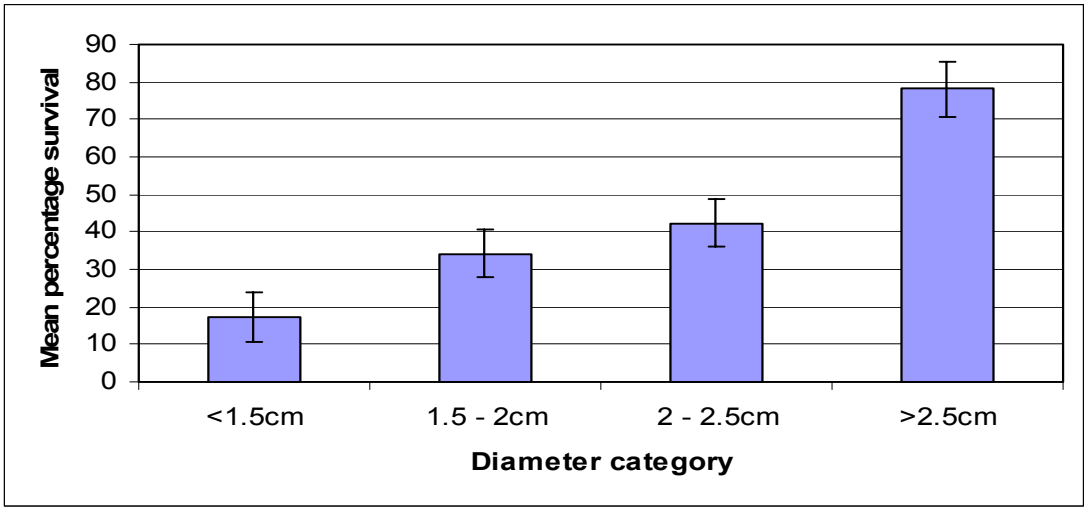

Figure 3. Relationship between survival and stem diameter of grafts.

This part of the project evaluates the feasibility of using grafting for mass propagation of resistant beech. The material produced in the trials is used for screening for resistance.

Resistance screening:
In July, 2003, beech scale eggs were collected from diseased trees by removing bark discs from heavily infested tree trunks. The eggs were removed from the bark with the aid of a fine paintbrush under a dissecting scope and were stored under cool moist conditions for several weeks until the grafts were sufficiently vigourous for inoculation. The grafted stems were inoculated by placing 50 scale eggs on small pieces of foam, which was wrapped around the stems (Houston 1982) grafted from diseased and undiseased trees (Fig. 4 a-d). After 12 months (July, 2004), the foam will be removed and stems will be examined for evidence of scale colonies. Successful establishment of scale colonies indicates susceptibility while the reverse indicates resistance.

Figure 4a. Bark disc removed from infested tree to collect scale eggs.

Figure 4b. Adult scale and eggs collected for resistance screening.

Figure 4c. Placing scale eggs on foam strip for inoculating beech graft.

Figure 4d. Grafted beech seedling inoculated by scale eggs.

Micropropagation:

A number of tissue types and techniques have been used to produce micropropagules of disease-free beech. Experiments conducted in 2003 have been more successful than previous attempts to produce plants through vegetative means, though plantlets have still not been successfully brought through dormancy. Most troublesome steps in micropropagation were identified and will be focused on in 2004. Buds were collected prior to bud swelling to reduce likelihood of contamination and were stored at <5°C until use. As contamination has been a major problem, alternative approaches to sterilization of material were tested and tests will continue in 2004. Outer bud scales were removed from sterilized vegetative buds and placed on shoot culture in test tubes (Fig. 5 a-f). Root suckers, collected in the field and induced in a greenhouse, were also cultured in 2003.

Contamination in late stages of propagation posed the greatest challenge. There was high variation among genotypes both in the degree of contamination (Fig. 6) and rooting success (Fig. 7). In 2004 we will concentrate on controlling the contamination problem.

The transfer from sterile culture to the greenhouse

Results from 2003 are encouraging. To date, only two studies reported a modest-scale success with micropopagation of American beech (Barker at al. 1997; Simpson, 2001) but in neither case it was possible to establish the plantlets in the soil. We were able to successfully transfer 50 plantlets to soil and they entered dormancy. However it appears that none of the plantlets are breaking dormancy. We will continue working to refine the procedures for transferring material from culture to non-sterile media.

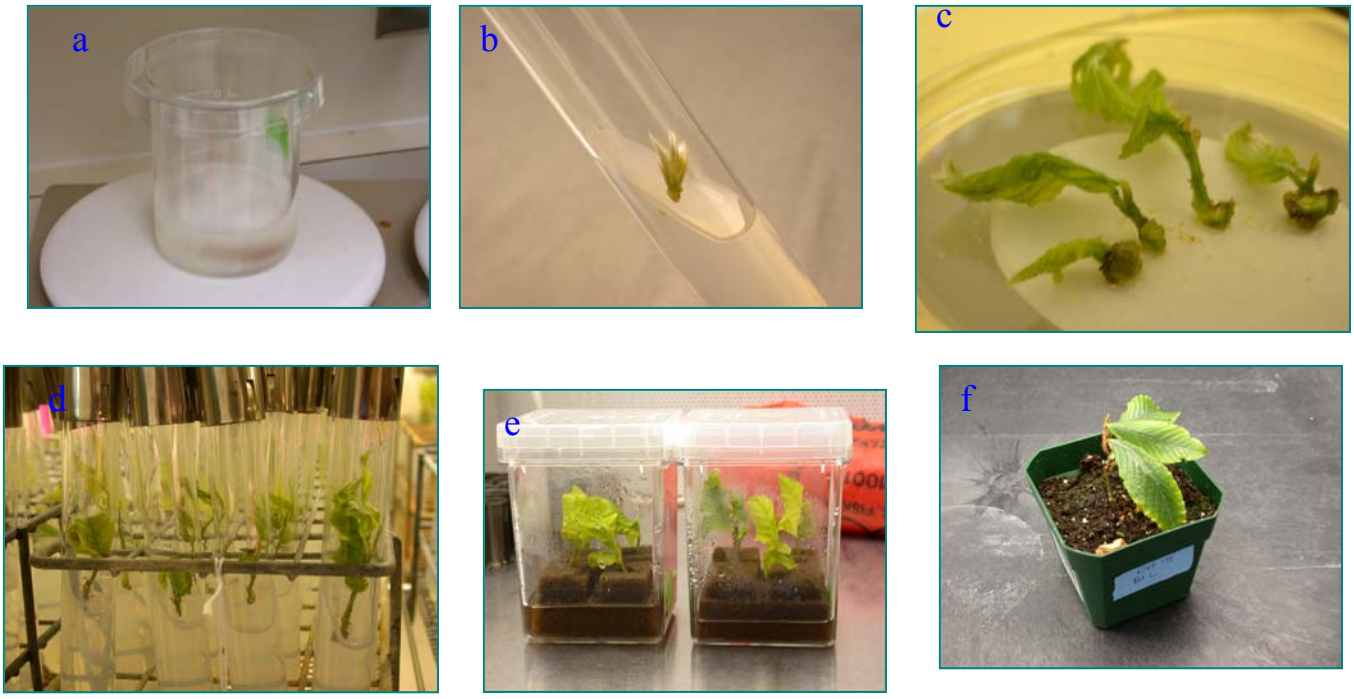

Figure 5. Micropropagation of buds: a. sterilization, b. bud in initiation medium, c. separation of shoots grown in culture, d. shoots in elongation medium, e. plantlets in rooting medium, and f. rooted plantlet transferred to soil.

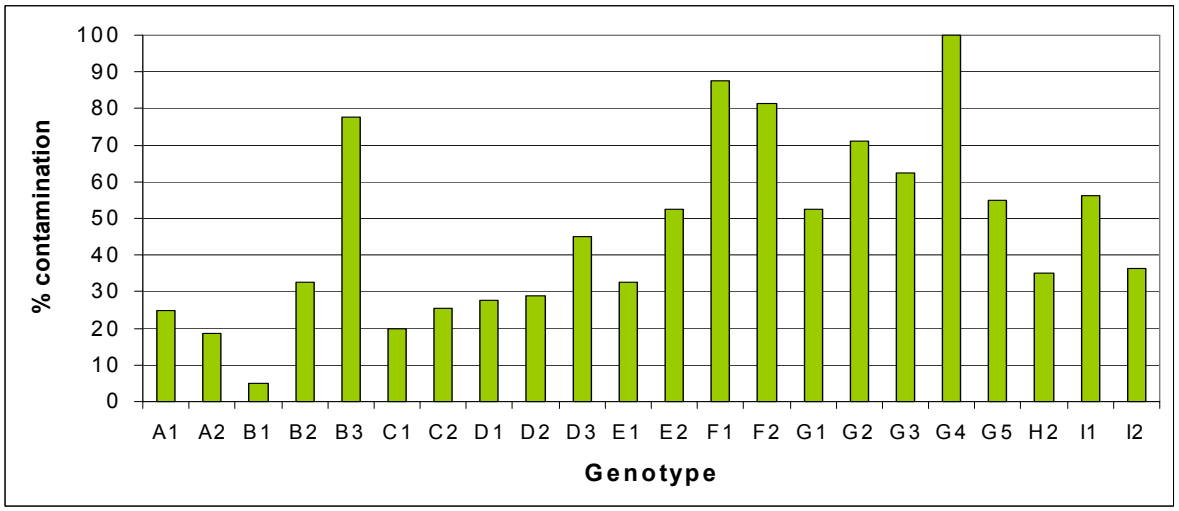

Figure 6. Percent contamination of bud tissue in culture by beech genotype.

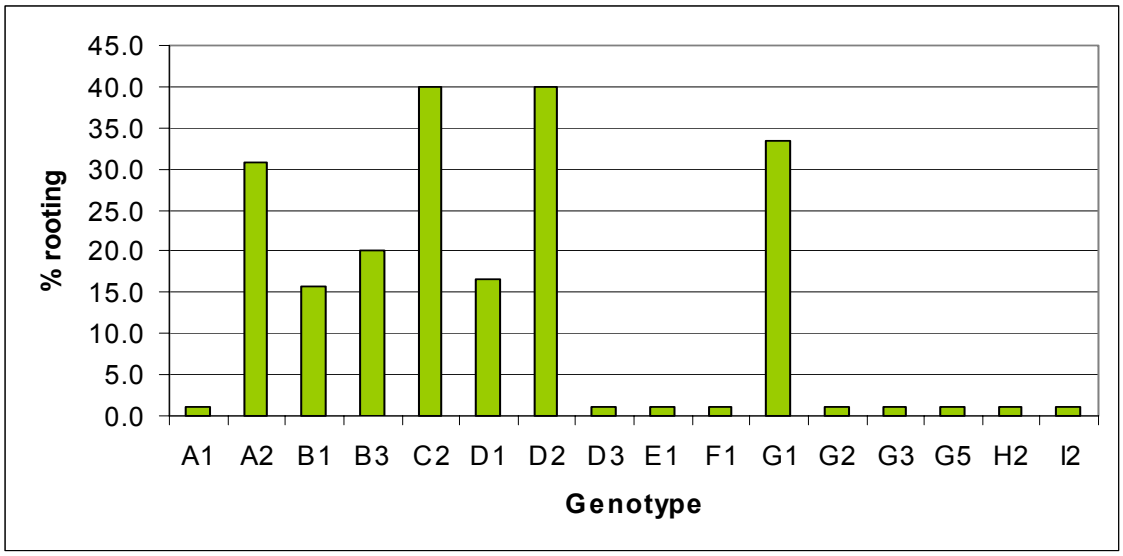

Figure 7. Rooting success of American beech plantlets by genotype.