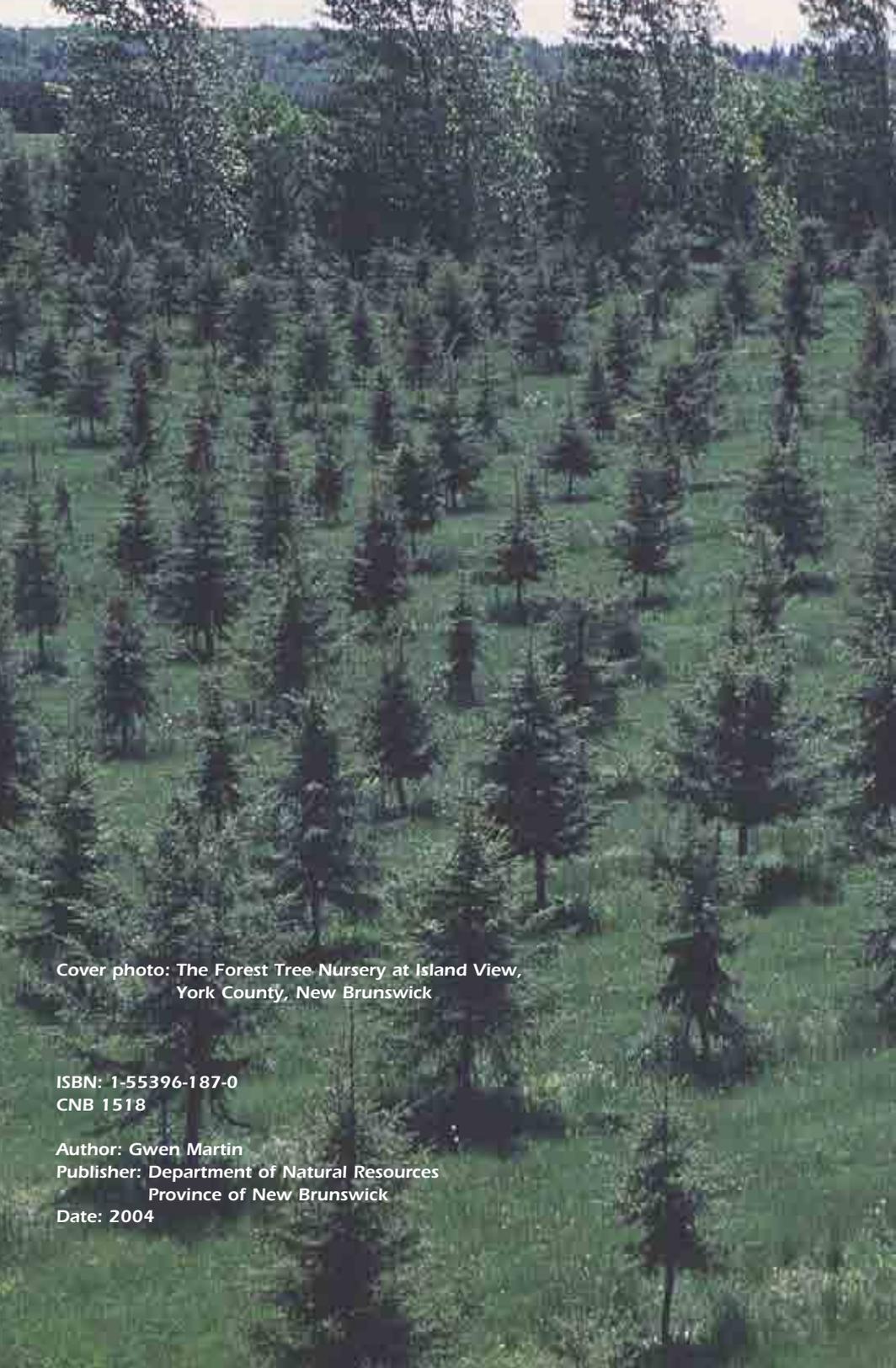


New Brunswick
Brunswick
CANADA

**KINGSCLEAR
FOREST TREE
NURSERY**





Cover photo: The Forest Tree Nursery at Island View,
York County, New Brunswick

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The Kingsclear Forest Tree Nursery lies a few kilometres west of Fredericton on a beautiful hillside overlooking the Saint John River. It is the only government-owned tree nursery in New Brunswick.

The Nursery is presently operated by the Department of Natural Resources. It is one of the largest facilities of its kind in Atlantic Canada and employs more than 100 people during peak season. The complex of buildings and orchards covers approximately 30 hectares and encompasses three separate but related operations.

The Forest Nursery

The Forest Nursery produces between 20 and 25 million tree seedlings per year. They are used almost exclusively for the reforestation of New Brunswick Crown land.

The Atlantic Forest Seed Centre

The Centre provides clean, high-quality seed for seedling production at the Forest Nursery. It also offers seed extraction, cleaning and storage services for other government and forest industry clients across the Atlantic provinces and Maine.

The Tree Improvement Program

The Tree Improvement Program supplies the Forest Nursery with genetically-improved seed. The seed is produced in Natural Resources' seed orchards from trees selected for their commercially-desirable genetic traits.

These three operations are vital to the sustainable management of New Brunswick's Crown forest. But before examining their forest management role, it is important to understand how the Forest Nursery, Seed Centre and Tree Improvement Program work on the ground.

The Forest Nursery

The Forest Nursery contains the equivalent of 70 greenhouses, each 10 m x 30 m. Their combined holding capacity totals 12 million seedlings.



Greenhouses : A good environment for seedlings

How Are Seedlings Produced?

All tree seedlings are grown in peat pellets. These pellets are composed of compressed peat manufactured from locally-harvested sphagnum moss at Jiffy Products Ltd. in Shippegan, northeastern New Brunswick. Peat is the ideal horticultural medium. It provides moisture and oxygen for young plants, and absorbs up to 20 times its weight in water. The fine mesh holding the pellet together allows roots to develop with minimal restriction.

The first step in seedling production is to sow the seed. Trays full of pellets move through a seeding machine that deposits one or two seeds per pellet. Encouraged by moisture and warmth in the greenhouse, the seeds germinate within two to three weeks. After germination, seedlings are thinned to a single plant per pellet.



Feeding a seeding machine

As seedlings grow, they are sampled every three weeks for height and root mass. The target size for shipment to the field is approximately 15 cm in height and 1.5 mm in root collar diameter. If measurements indicate that seedlings may not reach their target size on schedule, Nursery staff can adjust quantities of fertilizer, water and light to accelerate growth.

Roots sometimes develop between adjacent peat pellets while the seedlings mature. When this occurs, a cutting machine is used to separate the roots before the trees are sent to clients.

When Are Seedlings Produced?

Seedling production is staggered throughout the year to ensure that enough young trees are available for shipment during the planting season (late April-late September).

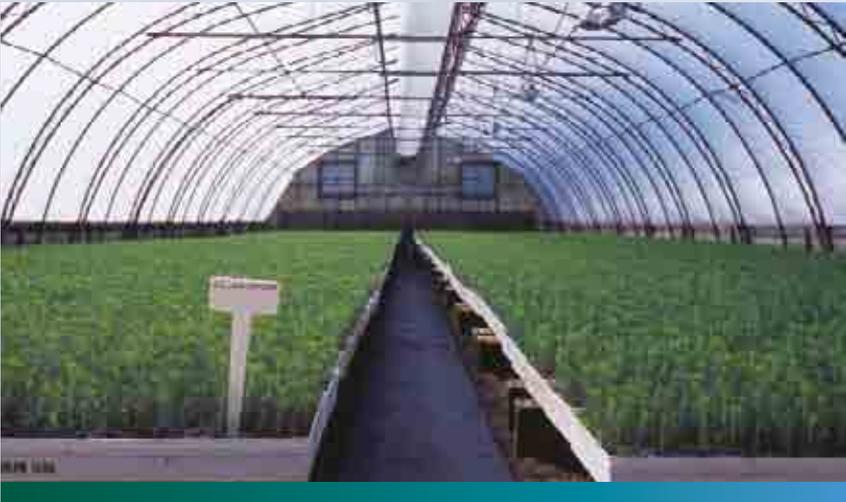
Typically a tree is out-planted one year after sowing. Most pellets are seeded between March and July. Seedlings usually spend between four and 18 weeks in the greenhouse, depending on when they were sown. They are then

placed outdoors in sheltered areas to make room for the next crop and to become accustomed to natural weather conditions. These seedlings remain outside all winter. Some of the trees are given extra protection from extreme cold by placing plastic or fabric blankets over them.

The Nursery also produces winter crops, when seedlings are needed to meet additional demand. Seed is sown in January and February in heated greenhouses and seedlings are shipped that same summer. Winter crops offer a faster turn-around time from sowing to planting, but are more expensive to grow due to extra heating costs.

When Are Seedlings Shipped?

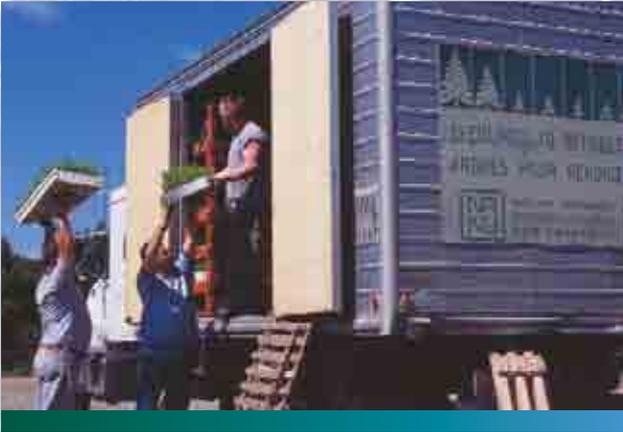
The Forest Nursery delivers seedlings to clients between late April and late September. Once in the field, seedlings must be planted as quickly as possible to minimize stress to roots



One greenhouse holds 200,000 seedlings

and foliage. The roots readily grow through the pellet mesh into their new soil environment. Within weeks, they will closely resemble natural root systems.

Who Receives the Seedlings?



Loading seedlings to be shipped to a planting site

Nursery seedlings are shipped to New Brunswick's major forest companies and are used to reforest the Crown land these companies have harvested. About 80 percent of the harvested area regenerates naturally. The remaining 20 percent (around 10,000 hectares) is replanted with approximately 20 million seedlings each year.

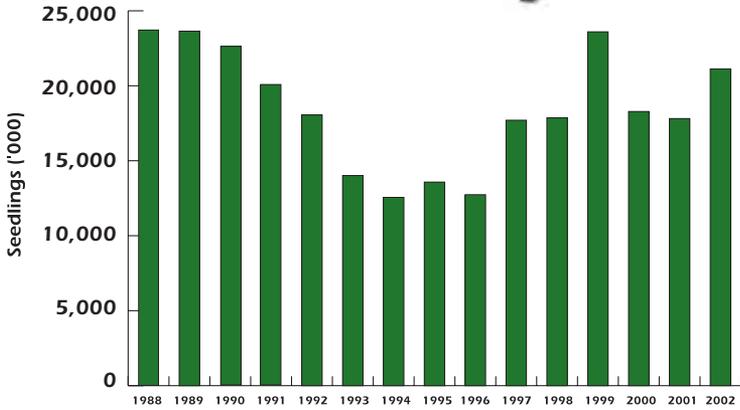
Some forest companies also operate their own nurseries to grow seedlings for the reforestation of industrial freehold land and other private woodlots.



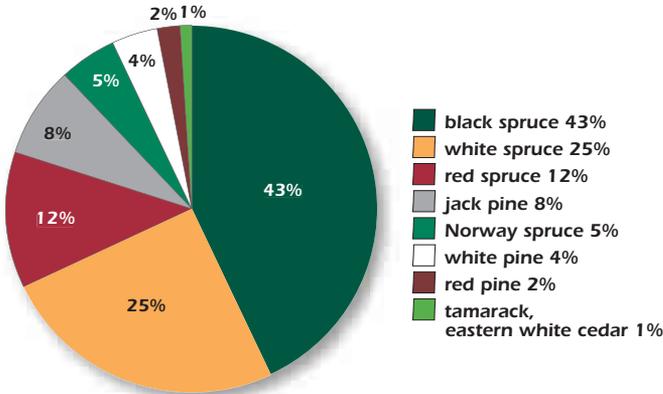
White spruce seeds

Planting a new tree

Seedlings Shipped



The Kingsclear Forest Nursery can produce more than 20 million seedlings annually. Actual production fluctuates with the level of Crown land reforestation each year.



Seedlings grown at the Forest Nursery are mainly black spruce, white spruce and red spruce, with smaller proportions of other coniferous species. This mix helps to preserve biodiversity, while meeting commercial requirements of the New Brunswick forest industry.

The Atlantic Forest Seed Centre

The Atlantic Forest Seed Centre was established in 1978 by the Department of Natural Resources.

The Seed Centre serves two important functions:

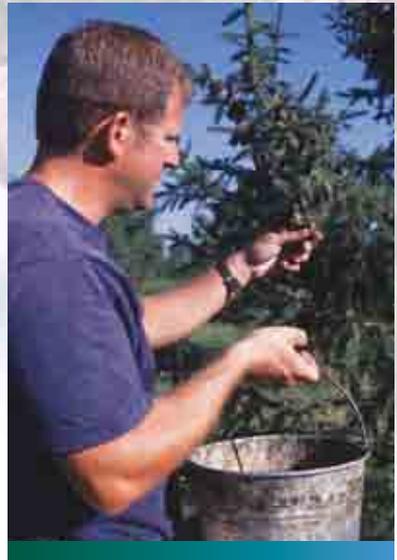
- It provides the Nursery with high-quality seed.
- It offers seed extraction, cleaning and storage facilities to forest industry and government clients across Atlantic Canada and Maine.

Seed Extraction

Tree cones are harvested between mid-August and the end of October once the seed has matured.

Cones arrive at the Seed Centre in large burlap bags and are hung in curing sheds. Air moves through the bags, allowing cones to ripen and lose moisture. After curing for several weeks, the cones are then moved indoors for seed extraction.

The next step involves heating the cones until they open their scales and drop the seed. The Centre uses five kiln-heated drums made of wire mesh. Each heated drum is loaded with 15 bags of cones, then rotated for an average of 16 hours until the loosened seed falls into the hoppers below.



White spruce seeds

Collecting cones in a seed orchard

Seed Cleaning

Hoppers beneath the extraction drums accumulate not just seed, but also fragments of cone, seed wings and other chaff. Before being stored, the seed must be thoroughly cleaned of all extraneous material. Cleaning is a five-step process.

- **Stage One: removes dust and larger waste particles. The seed-chaff mixture is fed into a clipper cleaner.**

This is a type of agricultural threshing machine.

The machine's vibrating screens separate the seed and seed-sized debris from dust and from particles that are larger than seed.

- **Stage Two: removes seed wings.**

The seed and seed-sized debris are mixed with water and placed in a rotating canister or de-winger lined with ridges. As the canister tumbles, the water-softened seed wings detach from the seed. The mixture of seed and wings is fed through a second clipper cleaner—usually several times—to remove as many wings and hollow seeds as possible.

- **Stage Three: removes pitch granules and dust.**

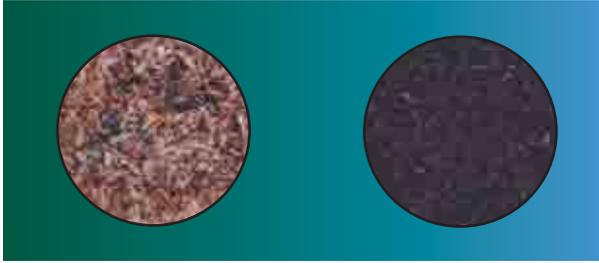
The seed is placed in a liquid separator or water flotation tank. Pitch granules and cone particles sink to the bottom, while good seed floats on the surface and is skimmed off.

- **Stage Four: dries the seed.**

Damp from the liquid separator, the seed goes into drying cabinets that slowly reduce its moisture content to between four and eight percent water.

▪ **Stage Five: the final touch-up.**

The fifth (and last) step uses a vacuum separator to remove any remaining bits of debris. In general, the heavier seed passes through the vacuum separator, while the lighter particles remain suspended in the airflow before falling off into side-chambers.



Seeds before cleaning

Seeds after cleaning

Seed Storage and Quality Testing

The cleaned seed is either returned to the client or stored in plastic containers at the Seed Centre for future use. The Centre's freezer vault is able to hold more than 3,000 kg of seed. Tree seed can be stored for many years under the appropriate moisture and temperature conditions: four to eight percent moisture content and -8°C respectively.

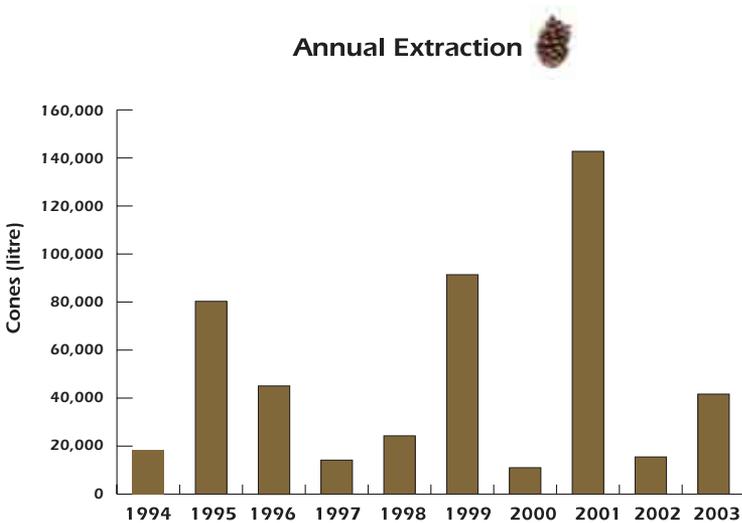
Staff at the Atlantic Forest Seed Centre conduct periodic tests to determine the quality of all stored seeds. Every seed batch is assessed according to International Seed Testing Standards, which measure such characteristics as germination percentage, moisture content, seed purity and seed weight.



Who Uses the Atlantic Forest Seed Centre?

The Seed Centre operates one of only two seed extraction facilities in Atlantic Canada, and its services are in high demand across the region.

A substantial portion of the output is used in the adjacent Forest Nursery for seedling production. The Seed Centre also processes cones for New Brunswick's large forest companies, and extracts balsam fir seed for woodlot owners engaged in Christmas tree production. As well, the Centre's services are used by private companies and government agencies from other Atlantic provinces and Maine.



The number of cones processed annually at the Atlantic Forest Seed Centre varies with the yearly cone crop and the volume of seed already in storage. Trees produce good cone crops every two to five years. A heavy cone year enables clients to accumulate larger volumes of seed, and usually is followed by one or two years of relatively low seed extraction at the Centre.

White spruce seeds

The Tree Improvement Program

What is Tree Improvement?

Tree improvement is a cyclical process that involves the selection of superior or plus trees with desirable genetic traits, and the improvement of those traits by breeding.

Natural Resources established its Tree Improvement Program in 1970. The program is designed to provide genetically-improved, locally-adapted seed for Crown land reforestation. It focuses on species required by the forest industry—black spruce, white spruce and jack pine, among others—and has two primary goals:

- **Select and improve desirable genetic traits to increase the harvest value of planted trees.**

Genetically-improved trees grow faster, have straighter trunks and form smaller branches than do unimproved trees. Plantations of such trees provide greater volumes of wood in a shorter period of time.

- **Maintain genetic diversity of New Brunswick forests.**

Tree improvement programs that use genetically-variable trees can utilize this variability for future generations of genetic improvement, and genetically-diverse forests adapt more easily to climatic change and other environmental shifts.

Tree improvement activities in New Brunswick work with natural, biological processes and do not involve genetic engineering.

Tree Improvement Cycle

Identify Plus Trees and Establish Seed Orchards

New Brunswick's tree improvement program began with the identification of plus trees in natural stands. To ensure genetic diversity, trees were chosen from sites across the province.

Next, genetic material was collected from the plus trees to establish first generation seed orchards. For some species



(for example, black spruce), seed cones were used. Seedlings grown from the extracted seed were planted in seedling seed orchards. For other species (for example, white spruce), branch tips or scions were cut from the plus trees and grafted onto small potted trees called root stock. The grafts were planted in clonal seed orchards.

White spruce seeds

Comparing improved (left) and natural trees





A spruce clonal seed orchard

These first generation orchards have supplied almost all the seed used at the Forest Nursery since 1991.

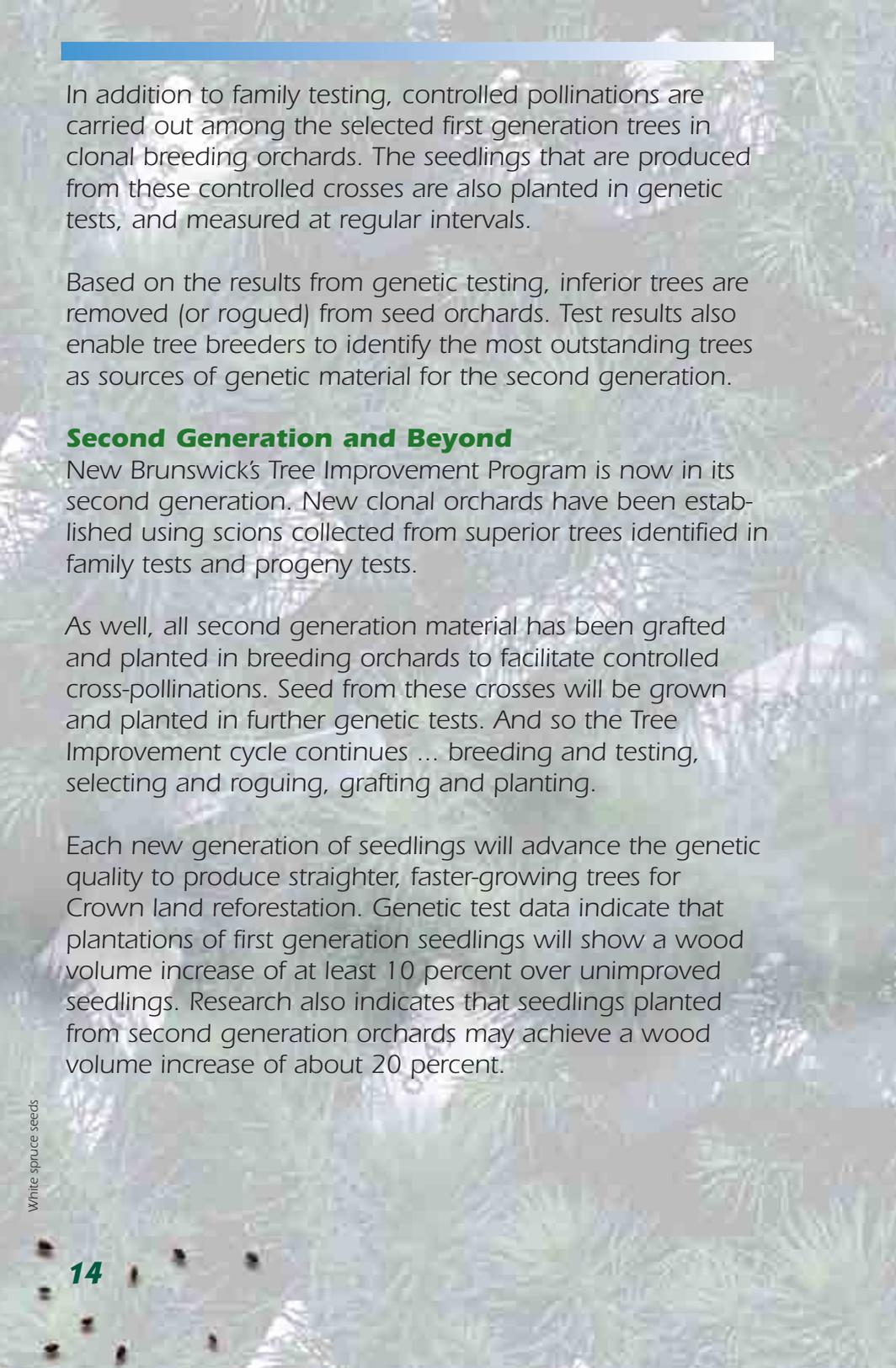
Genetic Testing

Genetic field tests are set up in conjunction with the establishment of seed orchards. Testing is carried out to ensure that progeny trees have the same excellent genetic qualities found in the parent trees.

The seedlings of each parent tree are grown and then planted at various locations throughout the province. The trees in these family tests are measured at five-year intervals for growth rate, straightness, and other characteristics, such as resistance to insect and disease.



Controlled cross-pollination



In addition to family testing, controlled pollinations are carried out among the selected first generation trees in clonal breeding orchards. The seedlings that are produced from these controlled crosses are also planted in genetic tests, and measured at regular intervals.

Based on the results from genetic testing, inferior trees are removed (or rogued) from seed orchards. Test results also enable tree breeders to identify the most outstanding trees as sources of genetic material for the second generation.

Second Generation and Beyond

New Brunswick's Tree Improvement Program is now in its second generation. New clonal orchards have been established using scions collected from superior trees identified in family tests and progeny tests.

As well, all second generation material has been grafted and planted in breeding orchards to facilitate controlled cross-pollinations. Seed from these crosses will be grown and planted in further genetic tests. And so the Tree Improvement cycle continues ... breeding and testing, selecting and roguing, grafting and planting.

Each new generation of seedlings will advance the genetic quality to produce straighter, faster-growing trees for Crown land reforestation. Genetic test data indicate that plantations of first generation seedlings will show a wood volume increase of at least 10 percent over unimproved seedlings. Research also indicates that seedlings planted from second generation orchards may achieve a wood volume increase of about 20 percent.

Where Does Tree Improvement Take Place?

Natural Resources maintains its Tree Improvement headquarters at the Kingsclear Forest Tree Nursery where several greenhouses, seed orchards and breeding orchards are dedicated to the program. The Department also operates other seed orchards at several locations across central and southwest New Brunswick.

Several of New Brunswick's private forest companies have established their own seed orchards around the province. The stock is used to reforest their freehold land.

New Brunswick Tree Improvement Council

The New Brunswick Tree Improvement Council was formed in 1976 to co-ordinate tree improvement activities in the province, and to facilitate the exchange of genetic material and information. The Council comprises representatives from Natural Resources, the New Brunswick forest industry, the Canadian Forest Service, University of New Brunswick and Université de Moncton.

Each member group contributes to the program. Natural Resources manages and co-ordinates Council activities. Industry members play a key role and are responsible for planting, managing and measuring genetic tests. The Canadian Forest Service conducts research on the genetics, biodiversity and biotechnology of trees, and helps to direct the program. Both universities conduct research and offer courses in forest genetics.

Additional studies are carried out collaboratively between Council members. Thanks to this co-operative environment, New Brunswick enjoys one of the most advanced tree improvement programs in Canada.

Crown Forest Management and the Kingsclear Nursery

The forest industry is an economic mainstay of New Brunswick. It generates billions of dollars in tax and export revenue, and employs thousands of people. To remain economically viable, the forest-based companies must rely on timber from Crown land and private industrial freehold.

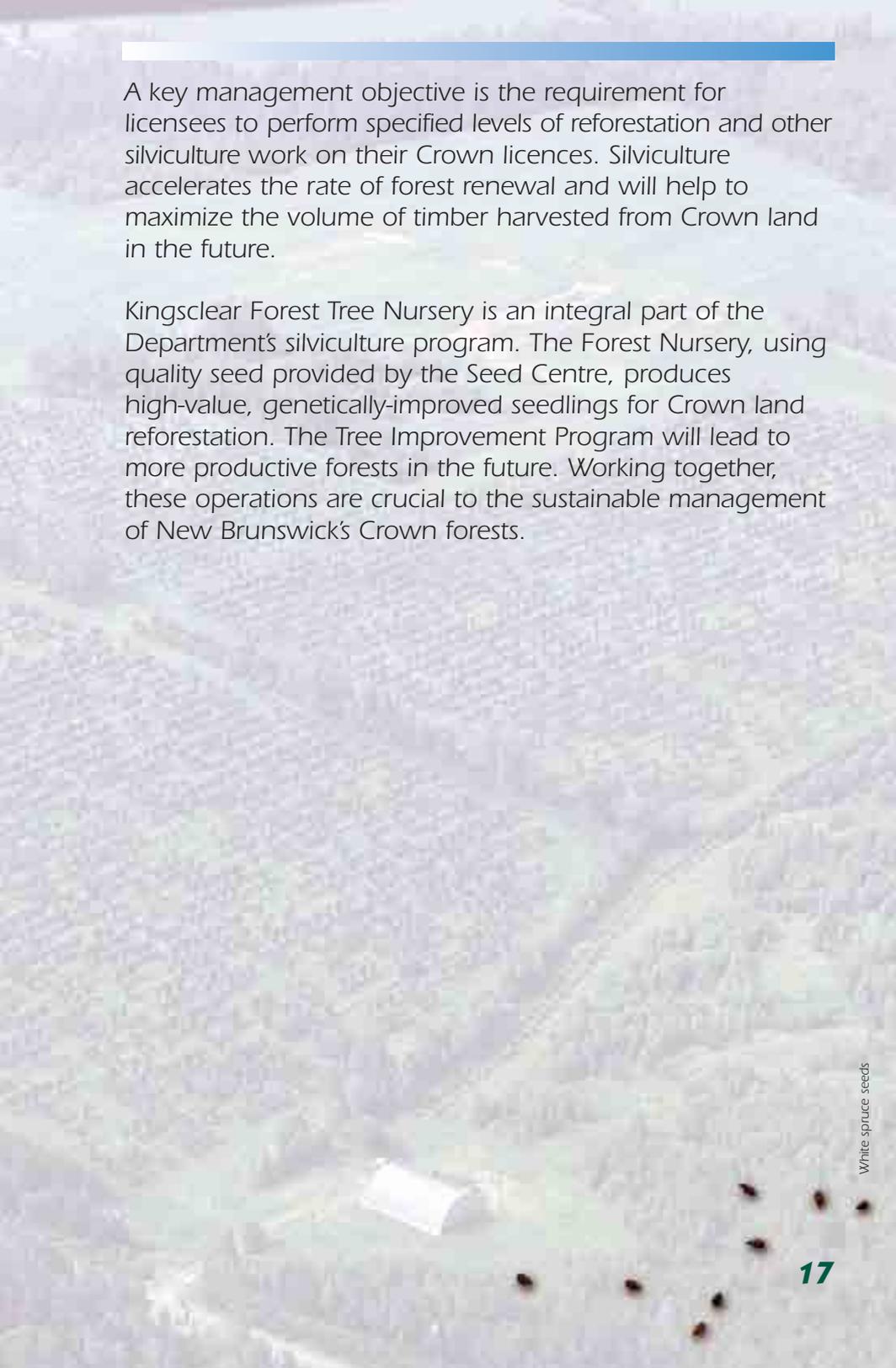
Crown forests represent approximately half of New Brunswick's productive forest land. Besides supplying timber, they provide wildlife habitat, protect water and air quality, and support outdoor recreation. Natural Resources manages Crown land to accommodate all forest values: economic, environmental and social.

The legislative basis of Crown forest management in New Brunswick is the *Crown Lands and Forests Act*. The Act divides Crown land into 10 timber licences, which presently are leased to six large forest companies called licensees.

Licensees are permitted to extract timber from their Crown land licences. In exchange, they must pay a fair market value royalty for the harvested wood. The revenue is used to support many government services including reforestation. Licensees also must adhere to forest management standards and objectives set by the Department.



Plantations increase wood volume

An aerial photograph of a forest landscape. In the foreground, there is a small white building with a dark roof, possibly a nursery or office. The forest extends into the distance, showing varying shades of green and brown, indicating different types of trees or stages of growth. The sky is a pale, hazy blue.

A key management objective is the requirement for licensees to perform specified levels of reforestation and other silviculture work on their Crown licences. Silviculture accelerates the rate of forest renewal and will help to maximize the volume of timber harvested from Crown land in the future.

Kingsclear Forest Tree Nursery is an integral part of the Department's silviculture program. The Forest Nursery, using quality seed provided by the Seed Centre, produces high-value, genetically-improved seedlings for Crown land reforestation. The Tree Improvement Program will lead to more productive forests in the future. Working together, these operations are crucial to the sustainable management of New Brunswick's Crown forests.

Notes

White spruce seeds

