TICtalk

FGC Forest Genetics Council of British Columbia

Information for and from the tree improvement community of British Columbia

Volume 2, Number 1, Spring 1999

Second Edition

Welcome to the second edition of *TICtalk*—the newsletter of British Columbia's Forest Genetics Council (FGC). This periodic publication provides information from the tree improvement community (the TIC in *TICtalk*) to a range of interested audiences. If you have an issue you'd like to contribute—or a burning question to be answered—please send it along (see back page for contact information).

Contents will include information about the FGC; issues faced by the industry; the latest in technical innovations, equipment, and management techniques; and general information on tree improvement. We will include feature articles on forest gene resource management from British Columbia's active research community, and information on upcoming courses, seminars, and conferences.

The first issue of TICtalk, published in spring 1996, and a series of backgrounders on Council and its work can be downloaded from the FGC website.

Tree Improvement/Forest Genetics Council: What's in a Name?

Tree Improvement Council

Tree improvement activities in British Columbia have historically been coordinated through cooperative councils, beginning with the Plus Tree Board in the 1960s and continuing with the Coastal and Interior Tree Improvement Councils from the late 1970s. In March 1997, the provincial Chief Forester merged the Coastal and Interior Tree Improvement Councils, and appointed a single transitional Tree Improvement Council of British Columbia (TIC). The mandate of the transitional TIC was *to develop and recommend an organizational structure among government, industry, Forest Renewal BC, and universities that will result in the efficient delivery of a forest genetics program in British Columbia.*

Acting on this mandate, the transitional TIC:

- developed a 10-year Strategic Plan, which outlines an organizational structure and identifies roles and responsibilities for stakeholders to cooperatively deliver a gene resource management program for forest trees for the period 1998–2007
- produced, with the assistance of the Coastal and Interior Technical Advisory Committees (TACs), a Business Plan that outlines the activities required to meet the goals and objectives of the Strategic Plan.

As one of its concluding activities, the transitional TIC recommended that the name "Forest Genetics Council of British Columbia (FGC)" be given to the permanent multi-stakeholder council that would set provincial goals and objectives related to forest gene resource management.

The Chief Forester endorsed the Council's Strategic and Business Plans in July 1998, including the new name and broader program scope implied by the new name.

An historical overview of the work of cooperative councils in tree improvement activities can be downloaded from the FGC website (see History backgrounder).

INSIDE

FGC on the Web

www.fgcouncil.bc.ca

Mandate and Objectives of the Forest Genetics Council

Forest gene resource management is a cooperative endeavor in British Columbia. Council's mandate is to champion forest gene resource management, to oversee strategic and operational planning for the provincial forest gene resource management program, and to advise the Chief Forester on forest gene resource management policies.

Council's objectives relate to the four main areas of forest gene resource management activity.

Council's objectives relate to gene conservation, controlled use, enhancement, communication and extension.

Activity	Objectives
Gene conservation is the maintenance, protection, restoration, and enhancement of genetic resources and genetic diversity.	To assure the availability of rare genes for future breeding and for the survival of wild populations through a program of *in situ* and *ex situ* gene conservation.
Controlled use is the management of existing germplasm to reduce risk in plantations by matching sites and genotypes (e.g., orchard licensing, seedlot registration, seed transfer rules).	To reduce risk in future forests by planting well-adapted and genetically diverse planting stock according to seed transfer limits.
Enhancement refers to selection and breeding to improve commercial value and increase the contribution of plantation forests to the economy of British Columbia.	To maximize the economic benefits from tree improvement investments for gains in wood quality, quantity, and pest tolerance consistent with strategic land use planning by: • doubling the average volume gain of genetically improved seed produced from 6 to 12% by 2007 • increasing genetically improved seed use to 75% of total provincial sowing by 2007 • identifying and funding the long-term production capability required to meet approved Business Plan priorities • monitoring progress in all aspects of gene resource management.
Communications and extension includes promotion, dissemination of policy and technical information, and establishment of a communications network for specialists and users.	To foster the support needed to achieve stakeholder goals for the provincial forest gene resource management program. To disseminate policy and technical information about forest gene resource management in British Columbia. To establish a communications network for gene resource management specialists and seed users. To provide seed users with information about the value of using genetically improved reforestation materials.

Information on specific directives to Council from the Chief Forester can be downloaded from the FGC website (see Mandate and Objectives backgrounder).

Forest Genetics Council Business Planning

submitted by Jack Woods and Jordan Tanz

Forest genetics activities in British Columbia have contributed to a greater understanding of genetic diversity and how to conserve and use it in managing forests. Many breeding programs have produced highly improved material, and orchard programs now generate seed for some 30% of the seedlings planted in the province.

The FGC carries out business analysis and planning to determine which investments will best meet its goal of maximizing economic benefits from tree improvement. The process involves:

1. ranking investments among programs (grouping by species, seed zone, and elevation band)
2. developing strategies for priority programs
3. preparing project-level plans that fit within the program strategies.

The FGC Business Plan is based on outputs from steps 1 and 2.

Setting Program Priorities

Genetic improvement programs could be implemented for more than 70 combinations of species, seed zone, and elevation band in B.C. (e.g., Hw/Maritime seed zone/<600 m). These potential programs are ranked for implementation according to the value they would return to the provincial economy through increased timber supply. The ranking system considers the following inputs for each potential program:

- annual hectares planted
- average MAI for sites within the seed zone
- average economic rotation
- expected gains in volume at rotation based on current test data and program stage
- value per cubic metre to the provincial economy
- anticipated gains from earlier green-up and adjacency relief.

These data are developed from biogeoclimatic/site index correlations and using TIPSY Economist, a stand growth and yield model developed by the Ministry of Forests Research Branch.

Potential programs are ranked based on their expected return to the province through increased timber supply.

Program Strategies and Plans

Species committees, comprised of representative stakeholders, develop strategic plans for programs that are biologically feasible and ranked high enough to merit investment. Annual plans and budgets are established for each program, and the activities and estimated costs for all programs constitute the FGC Business Plan.

This standard planning format allows clear comparisons of programs and provides a framework for communicating and understanding program strategies. It helps to coordinate stakeholder activities towards common objectives, and to guide external funding agencies, such as Forest Renewal BC.

Species committees of representative stakeholders develop strategic plans for high-ranking programs.

Together, the FGC Business Plan and Strategic Plan form a powerful planning tool for investing in tree improvement and forest genetics in British Columbia.

More information on Council's Business and Strategic Plans can be downloaded from the FGC website.

Forest Genetics Council Members

The new Council, appointed in November 1998, includes representatives from Ministry of Forests (MOF), Forest Renewal BC, forest companies, and universities.

Council is a multi-stakeholder body of TI cooperators in British Columbia

Co-chairs		
Shane Browne-Clayton	Riverside Forest Products Ltd.	Kelowna
Dale Draper	MOF Tree Improvement Branch	Victoria
TAC chair (coast)		
Sally Aitken	UBC Dept. of Forest Sciences	Vancouver
TAC chair (interior)		
Michael Carlson	MOF Kalamalka Forestry Centre	Vernon
Members at large		
John Barker	Western Forest Products	Vancouver
Henry Benskin	MOF Research Branch	Victoria
Janet Gagne	Forest Renewal BC	Victoria
Chris Hawkins	UNBC	Prince George
Mark Hopkins	Ainsworth Lumber Company Ltd.	Savona
Art Lacourciere	Weldwood of Canada Ltd.	Williams Lake
Diane Medves	MacMillan Bloedel Ltd.	Nanaimo
John Pollack	MOF Nelson Forest Region	Nelson
Ray Schultz	MOF Prince George Forest Region	Prince George

Forest Renewal BC's Tree Improvement Program

Support for OTIP projects increased from $1.8 million in 1997/8 to $3.2 million in 1998/9.

Further increases are anticipated for next fiscal year.

Since 1997, Forest Renewal BC has supported tree improvement activities through its proposal-driven Operational Tree Improvement Program (OTIP).

OTIP invests in increasing the production and quality of genetically improved materials for reforestation. The program's 10-year goal is to increase the amount of genetically improved material planted from current levels (30%) to 70%, and to enhance the genetic gain of reforestation materials from six to 12%.

OTIP funds activities in gene conservation, genetic testing, orchard/vegetative production, development of new production techniques, and new orchards. OTIP is administered through the Forest Genetics Council, which has set goals and priorities for the program and developed a process for reviewing potential investments.

Recognizing the tremendous potential gains from tree improvement, Forest Renewal has continued to expand its support of OTIP. In 1997/8, the first year of the program, 66 projects valued at $1.8 million were undertaken. The second year, 93 projects with a value of $3.2 million were funded. The program is again expected to grow in 1999/2000 and will begin to focus on the establishment of new orchard capacity.

Over the last two years, the FGC has worked with Forest Renewal BC staff to develop a broader tree improvement program that meets Forest Renewal's corporate objectives and achieves Council's goals for the provincial forest gene resource management program. Council and Forest Renewal hope that the program will be in place in the 1999/2000 fiscal year. Watch Council's website for further information.

For more information on OTIP, contact Roger Painter at (250) 356.9276 or roger.painter@gems8.gov.bc.ca

On a Web Browser Near You: www.fgcouncil.bc.ca

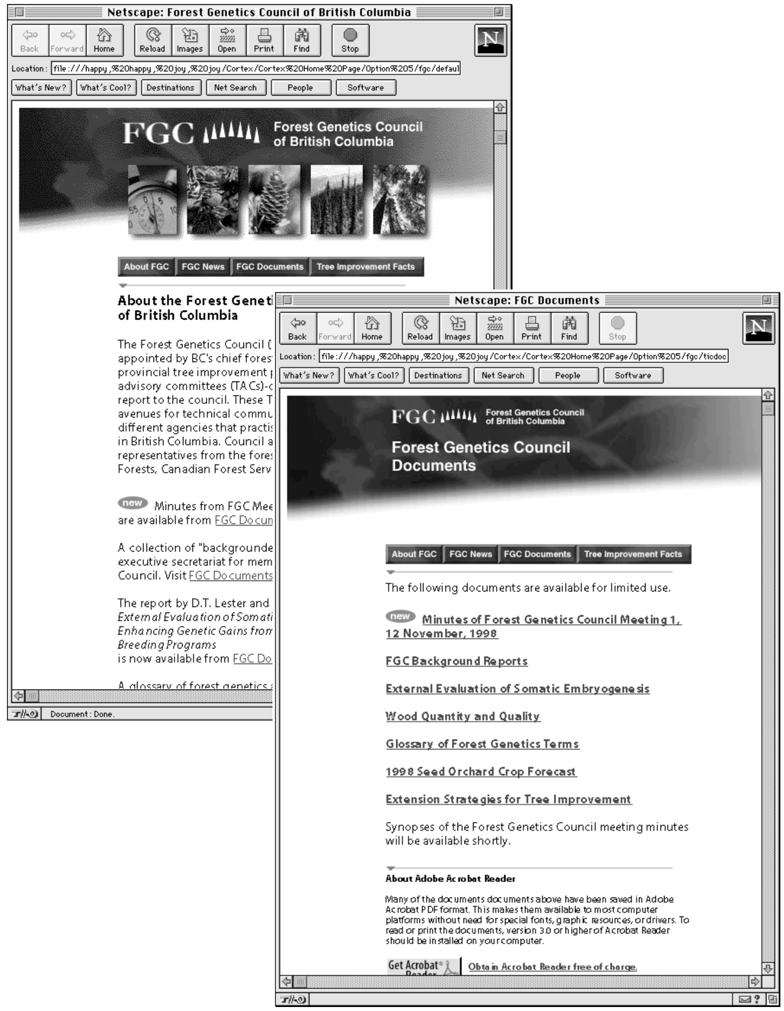
The Forest Genetics Council website was officially launched in October 1998 to provide up-to-the-minute FGC news, events, and key forest genetics documents.

Most of the reports are available as Adobe Acrobat PDF files (version 3.0). PDF files are universally readable by computers equipped with Acrobat Reader software. Reader is available free of charge from http://www.adobe.com. Netscape Navigator version 4.0 and MS Internet Explorer version 4.0 have an Acrobat Reader plugin already installed.

A sampling of documents currently available at www.fgcouncil.bc.ca:

- Minutes of Forest Genetics Council Meeting 1, 12 November, 1998
- FGC Background Reports
- External Evaluation of Somatic Embryogenesis
- Wood Quantity and Quality
- Glossary of Forest Genetics Terms
- 1998 Seed Orchard Crop Forecast
- Extension Strategies for Tree Improvement

Check back to the site periodically as the list continues to grow.



Forest Genetics, Adaptation, and Reforestation Decisions

submitted by Alvin Yanchuk

Almost every decision foresters make about harvesting and regeneration affects the genetic composition of the future forests they will manage, whether regeneration is by natural or artificial methods. Over time, annual choices can have substantial cumulative impacts across the landscape. Because each choice of a seedlot determines the genetic potential of the site for the life of the stand, foresters need to understand the genetic issues behind their silvicultural decisions.

Whether seed originates from wild-stand collections or seed orchards, the field forester's first concern is to ensure that the trees are "adapted to the site." It is important, therefore, that we understand and agree on the meaning of the term "adapted."

First, contrary to what many expect, the existing local stand of trees (population) is likely not the "optimal" seed source. Better sources, in terms of growth potential, likely exist elsewhere. This is because natural selection—particularly for long-lived organisms such as forest trees—cannot respond quickly enough to fluctuations in climate to maintain an "optimum adaptation." This effect, known as "adaptational lag," will vary depending on the three main evolutionary forces at work:

- *genetic drift*, the loss of potentially useful genes by random chance, which occurs when only a few individuals are the progenitors of the current stand. Genetic drift restricts the genetic base from which a stand can attain some optimum adaptation.
- *gene migration*, the movement of seed and pollen into a population by largely random forces, which can counteract the effects of natural selection (i.e., exert pressure on the population to not change genetically).
- *genetic selection*, where individual trees are subject to natural selection for many different characteristics at the same time. Complex interactions of several traits greatly slow the ability of a population to respond to one environmental pressure (e.g., frost).

Second, because similar environments occur in many areas of the province, several populations elsewhere are likely to have a similar "level of adaptation," and would be suitable seed sources. A neighbouring stand is not necessarily as well adapted as one some distance away. We know, for example, that a population of trees a few hundred kilometres north, at the same elevation, may be more similar in its growth rhythm than a closer stand that is 400 m higher in elevation.

Third, adaptation is an ongoing and gradual response. Trees can accommodate a wide range of soil and ecological conditions, just as they can accommodate wide climatic fluctuations from year to year. Therefore, populations are seldom either "adapted" or "not adapted." To assess adaptation, we can only look at morphological variables (such as height or diameter) or at physiological characteristics (such as drought or frost resistance). We describe a "level of adaptation" by measuring these variables and reporting our findings in statistical terms. Then we judge what level of adaptation is desirable or acceptable.

Finally, adaptation from a tree's perspective is survival and successful reproduction. From a forest management perspective, adaptation often includes survival and desirable log quality attributes (for the production of high quality forest products).

Individual trees or populations are said to be "adapted" to a particular environment if we expect them to have a good sample of the appropriate genes to grow and compete well in that location. "Adaptation," on the other hand, is used to refer to a population's ability to change genetically (i.e., the interactions of the three evolutionary forces mentioned earlier). Finally, an individual tree can also go through genetically

"…the choice of seed is the single most important decision in reforestation."

John Cuthbert, provincial Chief Forester, 1984–94.

controlled processes during its lifetime whereby it changes its morphology and physiology to accommodate annual changes in the immediate environment. We refer to these processes as "acclimatization" or "plasticity" but we could also say the tree is "adaptable." These three words, although seemingly indicating the same idea, mean something quite different at the genetic level.

To ensure that reforestation materials (seed, seedlings, cuttings, or other plants derived from tissue culture) are adapted to the particular reforestation site, we establish boundaries delineating the elevation and distance within which these materials can be transferred. These seed planning zone (SPZ) boundaries and transfer guidelines are based on information from provenance studies and from progeny and genetic testing experiments. But even for those species on which we have done extensive genetic testing (e.g., lodgepole pine, coastal Douglas-fir), our information is never complete; we must rely on our best judgment when developing operational guidelines.

For species with less available information (e.g., true firs, whitebark pine), our more conservative approach assumes that genetic variation tracks geographic and physiographic variation. Seed transfer guidelines and breeding/seed orchard zone boundaries will continue to evolve as we obtain new information on patterns of genetic variation for the commercial tree species.

To meet reforestation demands, large quantities of seed are being moved from both wild stands and seed orchards. The development and use of SPZs and transfer guidelines ensures that reforestation materials are adapted to the sites on which they are deployed.

SPZ boundaries and transfer guidelines ensure that reforestation materials are adapted to the sites on which they are deployed.

Abies Seed Production: Towards Securing Future Seed Supply

submitted by Joe Webber

The rise in seedling requests for *Abies* species over the past 15 years has focused attention on current and long-term seed supply to meet the growing demand for reforestation stock. Planting numbers for all *Abies* species more than doubled from 1984 (3.8 million) to 1994 (8.9 million). Sowing requests have declined, however, from about 10 million seedlings in 1997 to 5.5 million in 1999 (SPAR Nursery Extract files).

While demand for all *Abies* reforestation species is expected to continue to be strong, securing long-term supplies of seed is becoming problematic. On the coast, established amabilis fir (*Abies amabilis*) seed orchards have yet to produce an operational crop. On the north coast, harvesting threatens good seed-producing stands. Natural-stand seed crops of *Abies* species are periodic—abundant seed crops occur every 4–7 years. Even with a plentiful crop, seed quality (viability and germination) varies considerably. Reliable management of these species is based on understanding the factors affecting natural-stand production (induction and maturation of a crop), as well as investigating alternate strategies for procuring future seed supplies.

A research project funded by Forest Renewal BC (HQ96410-RE) is using two approaches to determine the barriers of seed production in *Abies* species. First, we are monitoring stands of amabilis fir and subalpine fir (*Abies lasiocarpa*) in two locations for each species to obtain baseline information on the variation in annual production of both seed- and pollen-cone crops and seed quality. Second, we are attempting to rapidly develop crown structure of grafted stock and then use standard flower induction techniques to determine the cultural and environmental factors affecting flower induction in both species.

We have now completed three years of monitoring and graft establishment and have identified four options for procuring future seed supplies.

1 Study seed production factors at the stand level

Both abiotic (temperature and precipitation) and biotic (pollen cloud density, insects) factors limit the production of high quality seed. During the first few days of seed cone receptivity, frost can cause significant losses (due to cone abortion) and may damage recently shed pollen. For those seed cones that survive frost, insect damage can also seriously impede production.

We are monitoring two sites in Terrace (for both species) and two research installations—one at the Sicamous Creek Silvicultural Systems Project (subalpine fir) and one at the Montane Alternative Silvicultural Systems (MASS) site (amabilis fir). Annual monitoring includes helicopter assessment of flowering intensity, assessment of pollen cloud density during the period of seed cone receptivity, and fall cone analyses.

Results from three years of monitoring production in natural stands show considerable variation between sites for cone and seed yields (see table). Potential yields for amabilis and subalpine fir are about 400 and 150 filled seed per cone, respectively. However, experience from cone harvesting suggests that values of 45 and 48 viable filled seeds per cone for amabilis and subalpine fir are more typical. Average filled seed per cone ranged from a high of 100 (Terrace) to a low of 44 (MASS) for amabilis fir, and 169 (Terrace) to 29 (Sicamous) for subalpine fir. For both species, the Terrace sites produced consistently higher yields than the MASS and Sicamous sites.

Work is underway to secure long-term supplies of *Abies* seed.

Crop intensity and seed yields for amabilis and subalpine fir from each of two sites for three years of monitoring.

	Amabilis Fir				Subalpine Fir			
	Terrace		MASS		Terrace		Sicamous	
Year	Crop[a]	Yields[b]	Crop	Yields	Crop	Yields	Crop	Yields
1996	L/M	88	L/M	44	L/M	54	NC/L	36
1997	M	NC	M/G	58	M	77	L/M	29
1998	L/M	100	L	NC	G	169	L	NC

[a] L=light crop with <10 seed cones/tree; M=moderate crop with 11–100 seed cones/tree; G=good crop with >100 seed cones/tree; NC=no cone crop

[b] expressed as filled seed per cone

Pollen cloud density does not seem to be limiting at either site. At Terrace, the incidence of frost damage was high, and at the MASS site insect damage appeared to be the principal barrier to good production. A combination of frost and insects (cone midge) was apparent at Sicamous. We will continue to monitor these sites in 1999 and 2000 and will attempt to determine seed quality (germination) as well.

2 Improve our knowledge of the reproductive biology of *Abies* spp.

We have some knowledge about the sequence of events leading to the initiation and differentiation of flowering structures, but nothing of the mechanism(s) that cause flowering. From experience, we know that tree vigour, temperature, and precipitation are important factors associated with flowering, but do not know when or in what combinations they must be applied. To determine the effect of these factors on initiation and differentiation of seed and pollen cones in both species, in the spring of 1999 we will begin procedures to induce flowering (heat, drought, root pruning, and gibberellin treatments) in our 4- and 3-year old grafted stock for both species.

3 Improve orchard production of *Abies* spp.

The final part of our *Abies* studies will focus on orchard production—specifically, why coastal orchards are producing copious quantities of pollen but few, if any, seed cones. Results from our accelerated crown development studies of grafted stock are expected to help identify the factors affecting poor seed cone response of coastal orchard stock. We are also closely following the flower induction and pollination studies of Professor John Owens, University of Victoria, to determine the role of pollen as a limiting factor in cone yields.

4 Rely on natural stands

Recommendations for flower induction and seed orchard management will not be available for several years. In the meantime, we must rely on natural-stand production to meet our annual needs for reforestation propagules.

Clearly, annual variation in cone production and seed quality for both species varies considerably, and as long as good flower stands remain, then future seed supplies will be secured. However, the rapid rate of harvesting now threatens these good stands. Our first course of action must be to locate these stands and protect them for future cone production.

We can do little to actually protect natural stands from frost and insect predation. We may be able to develop real alternatives to natural-stand seed production (orchards, seed production areas) but our most reliable source of seed will remain natural stands. They must be our first priority in developing a comprehensive strategy for securing long-term seed supplies of both amabilis and subalpine fir.

Wild-stand seeds must meet short-term demand until seed orchards begin to produce.

Screening Spruce for Genetic Resistance to White Pine Weevil

submitted by Rene I. Alfaro, John N. King, Cheng Ying, George Brown, Kornelia G. Lewis

White pine weevil reduces growth and causes deformities on spruce regeneration.

The white pine weevil, *Pissodes strobi,* is the most serious native pest of spruce regeneration in British Columbia, attacking primarily Sitka (*Picea sitchensis*), white (*P. glauca*), and Engelmann spruce (*P. engelmanni*).

The weevil has one generation a year. The eggs are laid from late April to June in punctures made by the female in the bark below the buds of the terminal (year-old) shoot. The larvae burrow downward in the bark, feeding on the phloem, which eventually kills the terminal. Destruction of the apical shoot reduces growth and causes deformities.

The Canadian Forest Service (CFS) is monitoring several Ministry of Forests (MOF) progeny trials in the screening of white pine weevil-resistant trees (see table). In the future, CFS plans to incorporate weevil resistance into an Integrated Pest Management System.

Ministry of Forest (MOF) progeny trials being monitored by the Canadian Forest Service (CFS) in the screening of *Pissodes strobi* resistant trees.

Site	Initial MOF planting date	No. of spruce families	No. of replicates	Date of weevil enhancement[a]	Year CFS began monitoring weevil attacks[b]
Sayward[c]	1992	168	15	Sept/96 (4)	1996
Espinosa Ck.	1991	151	15	---	1996
Port Renfrew	1993	72	12	Oct /97 (3)	1997
Clearwater	1984	139	8	---	1993
Jordan River	1991	75	24	Oct/94 (3)	1995
Cowichan Lk.	1992	75	24	May/96 (2)	1996
Big Tree Ck.[d]	1974	[e]		---	1988
Fair Harbour[d]	1984	38	16	---	1991

[a] To accelerate the screening process, augmentation with weevils was done at four of the sites (--- indicates only natural infestations monitored). The number of weevils placed on each tree in the release area is given in parentheses.

[b] Attack history was recorded in the first year of monitoring by examining each tree for past weevil attack.

[c] This trial was planted in two areas approximately 500 m apart; one area off Armishaw Road and the other off Glenroy Road.

[d] Big Tree Ck. is a IUFRO trial. Fair Harbour and this site are now being monitored on a five-year basis.

[e] This trial consisted of 34 provenances represented by 5–14 families per provenance for a total of 4389 trees.

White Spruce

A large family trial near Clearwater, British Columbia, has been surveyed annually between 1993 and 1998 for weevil resistance. The latest results confirm the preliminary resistance ranking of each family developed in 1994 using an index that measured:

- intensity of attack (number of attacks per tree)
- severity of each attack (how many internodes were destroyed)
- tree tolerance to attack (i.e., if tree develops good form after an attack).

The study demonstrated significant genetic variation in the attack resistance. This variation in resistance was related to ecoclimatic conditions of the parental tree source. Those parents from locations with high weevil hazard yielded a higher proportion of resistant trees. These sites are primarily low elevation, low latitude sites, especially on moist-warm habitats of the Sub-Boreal Spruce (SBS) biogeoclimatic zone. It has been postulated that high selection pressures in high weevil hazard zones increase the proportion of resistant trees in these areas.

Sitka Spruce

On Vancouver Island, researchers have conducted screening in replicated test plots near Jordan River, Cowichan Lake, Sayward (Big Tree Creek, Armishaw, and Glenroy Roads), Espinosa Creek, Fair Harbour, and Port Renfrew. Early results published in 1990/91 identified resistance from B.C. sources near Mission and the Big Qualicum area. Recent results, obtained from measurements of weevil attack in new trials established by MOF, confirm Big Qualicum as a good source of resistant genotypes.

To accelerate the screening process and create a uniform weevil pressure, insect populations have been augmented at several trials. Spruce families with resistance have withstood very high weevil populations. At Port Renfrew, weevil attack was increased from less than 1% per year to 51% in one year, yielding new selections. We hope that these new selections, along with earlier results, will lead to successful establishment of Sitka spruce plantations in British Columbia.

CFS monitoring of MOF progeny trials confirms Big Qualicum as a good source of weevil-resistant genotypes of Sitka spruce.

These trials are also yielding important information on the population dynamics of the white pine weevil, the importance of its parasitoids in population control, the role of fungi in the weevil/host system, and possible resistance mechanisms.

Integrated Pest Management System

An Integrated Pest Management System (IPM) has been proposed for *P. strobi*. This system relies on restoring ecosystem balance by reducing the conditions that led to outbreak development. The tactics depend on a preliminary weevil hazard rating of the area. In low hazard areas, tactics such as planting a mixture of species and planting at higher densities may be sufficient to produce a successful spruce crop. In high hazard areas, the silvicultural prescription could include the use of weevil-resistant stock.

Breeding for White Pine Blister Rust Resistance: The Kalamalka White Pine Seed Orchard

submitted by Michael Carlson, Ward Strong, Chris Walsh, Alvin Yanchuk

Researchers and silviculturists are working to develop rust-resistant white pines to re-establish B.C.'s white pine industry.

Western white pine (*Pinus monticola*), a five-needle pine native to the coastal and moist southern interior regions of British Columbia, produces high value wood. The market price of western white pine logs is two to three times that of other species in the province, comparable only to western redcedar (*Thuja plicata*) and yellow-cedar (*Chamaecyparis nootkatensis*).

Unfortunately, white pine blister rust (*Cronartium ribicola*) currently prevents the establishment of western white pine in sufficient numbers to be commercially viable. The blister rust is an exotic (non-native) pathogen that was introduced to B.C. in a 1918 shipment of pine seedlings from Europe. Encountering little resistance in native populations of western white pine, the fungus spread quickly throughout the province and into adjacent areas of the United States. Entire stands died, and today logging of this valuable tree is limited. Researchers and silviculturists at the Ministry of Forests (MOF) are working to develop rust-resistant white pines in an effort to re-establish the white pine industry in British Columbia.

Blister Rust

White pine blister rust is a fungal disease with two hosts: *Ribes* species (gooseberries, currants, etc.) and five-needle pines. Spores released from *Ribes* plants infect pine needles in late summer, causing small spots. The rust progresses into the bark the following year, and slowly moves down the branch towards the stem. Spores released from bark cankers reinfect *Ribes* plants. If the bark cankers on pine reach and girdle the stem, the tree dies. Young trees are at greatest risk because the needles are close to or on the stem, and the higher humidity near the ground favours survival and germination of the rust spores.

Breeding for Blister Rust Resistance: The Idaho Beginnings

In the early 1950s, researchers led by Dr. Dick Bingham scoured Idaho white pine forests for blister rust survivors. Of the 400 they found, about 25% were determined to have survived due to rust resistance, and the rest were "chance" escapes. After conducting controlled crosses, the progeny (F_1) were inoculated with blister rust to determine the resistance mechanisms. Resistant F_1s were planted at the Canyon Creek plantation on the Priest River Experimental Station, and controlled crosses with these yielded F_2 progeny, of which 32 were planted at the Moscow Arboretum.

In 1967, the Phase II selection program began under the auspices of the Inland Empire Tree Improvement Cooperative. Some 3000 wild survivors were selected as candidate parents. Open-pollinated progeny (half-sib F_1s) were inoculated with blister rust and observed for four years to screen for resistance and determine the resistance mechanisms. Selected individuals from these tests were planted in a 1st-generation seed orchard at Coeur d'Alene. A 2nd-generation orchard is planned, based on field test results of progeny from the 1st-generation orchard.

Rust-resistance Mechanisms

The Idaho research program identified several types of rust resistance, which fall into two broad categories: vertical resistance and horizontal resistance (see inset on Resistance Mechanisms to White Pine Blister Rust).

Vertical resistance is conferred by a single gene for each mechanism. Progeny show the trait if they have the gene. The resistance tends to kill or completely stop disease progress, but new strains of rust can overcome the resistance.

Horizontal resistance is due to many interacting genes for each mechanism, and progeny can show greater or lesser levels of resistance. Horizontal resistance tends to slow the progress of the disease, and is durable despite the development of new rust strains.

Resistance Mechanisms to White Pine Blister Rust

White pine can mount resistance to blister rust at many stages of disease progression. Resistance has been categorized to include the following mechanisms:

Name	Resistance mechanism	Description
Spots-Zero	vertical	No needle spots found; rust never infected the tree
Needle Spot Frequency	horizontal	Fewer needle spots found than in susceptible trees
Needle Shed	vertical	Needles are shed before the rust can move down the needle into the bark
Fungicidal Short Shoot	vertical	The fungus moves down the needle but is killed when it attempts to invade the bark
Bark Reaction: Dead	vertical	The fungus invades the bark, but the bark mounts a defence that stops and kills the lesion
Bark Reaction: Slow Canker	horizontal	The fungus invades the bark, but the bark mounts a defence that causes the lesion to grow slowly
Canker Alive	horizontal	The canker encircles the stem but the tree survives

The B.C. White Pine Breeding Program

In the early 1980s, Canadian Forest Service (CFS) researchers Drs. Mike Meagher and Rich Hunt established a B.C. program for blister rust resistance modeled after the Idaho research program. Subsequent research on seed transfer limits for white pine has shown that geographic origin is of little importance. Unlike most conifer species, western white pine from northern Idaho is appropriate for planting in British Columbia.

Rust-free wild trees were identified in areas of high rust risk in B.C. Open-pollinated F_1 seeds were collected, sown, and greenhouse-grown at Canadian Forest Products Seed Orchard (now owned by Western Forest Products) in Saanich. They were inoculated with spores from a *Ribes* garden there, then moved to Cowichan Lake Research Station where they were observed for three years for rust resistance.

Researchers from the CFS and MOF working at Cowichan Lake are now in the seventh round of screening for resistance among F_1 progeny of the original wild parents. Trees are selected based on family rankings (resistance among all progeny from a single parent tree) and individual performance (correct type and mix of resistance mechanisms).

The selected trees are cloned by grafting, and moved to a holding bed at the MOF Kalamalka Seed Orchards in Vernon.

Rust-resistant White Pine Seed Orchard for the B.C. Interior

In 1995, the MOF established an orchard at the Bailey Road site of the Kalamalka Seed Orchards south of Vernon to produce seed for regenerating rust-resistant white pine forests in the B.C. interior. Some 80% of the orchard trees were grown from scions collected at Idaho's Canyon Creek plantation. Four B.C. researchers, led by Drs. Michael Carlson and Alvin Yanchuk, selected the 50 source trees based on their resistance mechanisms: needle shed, short shoot, or bark reaction. At Skimikin Seed Orchard near Salmon Arm, 2000 trees were grafted, then transplanted to the Bailey site in 1995. The other 20% of the trees are from B.C. material selected at Cowichan Lake starting in 1996. Annual selections are transplanted to the Bailey site.

This process should be complete by year 2000 with all orchard positions filled. Tree location within the orchard is randomized to encourage outcrossing and maximize the types of resistance found in any one seed. Orchard manager Chris Walsh expects the trees to start producing seed by about 2002. These genetically improved seeds will be the basis for resurrecting the white pine industry in British Columbia.

Rust-resistant trees at Kalamalka Seed Orchards in Vernon are expected to be producing seed by 2002.

Western Redcedar Pollen Management

submitted by Oldrich Hak

Western redcedar (Cw) displays unique sexual reproduction. No other commercial tree species reproduces successfully during frequent winter storms when heavy rains and freezing cold make the conditions miserable to even think about reproduction. This environmental preference presents a challenge to Cw breeders and orchard personnel interested in supplemental mass pollination. Securing an adequate pollen supply is an equally challenging task.

In 1995, when the Ministry of Forests Research Branch introduced the Western Redcedar Breeding Program, no information on Cw pollen management was available. At that time, the practice was to employ pollen management techniques that worked for other tree species—forcing pollen shedding in a warm temperature and low humidity environment, and drying it to a very low moisture content. This approach failed for western redcedar.

Research and trials carried out by the orchard staff at Western Forest Products have shown that requirements for forcing, processing, and storing Cw pollen are unlike those of other commercial tree species. Based on their work, WFP staff have developed handling and storage techniques for Cw pollen that lay the groundwork for pollen management:

- Pollen forcing works only if branches with pollen cones are collected during the last stage of pollen development (i.e., one day prior to pollen shedding or later). Pollen branches must be protected from rapid desiccation (e.g., moderate amounts kept in closed paper bags).
- The room conditions required for the final development and shedding are high humidity (60–70% relative humidity) and cool temperature (15–17^{0}C).
- Pollen deteriorates rapidly at room temperature. To maintain high pollen viability, extraction and drying (if required) should be done after two days of pollen forcing. If pollen fails to shed, the collection of branches was done too early.
- Lowering pollen moisture content decreases its viability. For short-term storage (1–4 days), pollen should be dried only to the stage when it flows freely and is suitable for pollination (e.g., 15–25% moisture content), and then stored in a fridge (2–4^{0}C). For extended storage (5–19 days), the same pollen should be frozen and later defrosted in a fridge before use. Frozen pollen with higher moisture content (e.g., above 20% MC) will form clumps during freezing and may have to be sifted through a fine mesh before pollination. For long-term storage (20 days to 1 year), pollen should be dried to only 9–10% MC and stored in a freezer (-18^{0}C).
- Wet pollen (up to 60% MC), frozen at -18^{0}C to a solid mass, maintained its high viability during short term storage (not recommended for pollination); after one year in storage, the viability was zero.

These results were first presented at the annual meeting of WFP's Seed Orchard Staff Group in 1997. Other seed orchards and Ministry of Forests breeder and research personnel are now using these techniques.

Results from short- and long-term storage trials will be published in the next issue of *TICtalk.*

Western Forest Products staff have developed innovative pollen handling and storage techniques for western redcedar.

TimberWest Forest Limited Mount Newton Seed Orchards

submitted by Tim Crowder

TimberWest Forest Limited operates exclusively in coastal British Columbia, harvesting and selling logs, and processing and selling softwood lumber. TimberWest has approximately 334 000 hectares of fee-simple (private) timberland and holds rights to two area-based tree farm licences and several volume-based forest licences. The private land and Crown tenures have a combined current allowable annual cut (AAC) of 3.8 million m^3, of which approximately 2.4 million m^3 comes from the private timberlands. The company owns lumbermill complexes at Campbell River and Youbou on Vancouver Island, and operates as an income-bearing trust fund (TimberWest Timber Trust), publicly traded on the Toronto Stock Exchange.

Mount Newton Seed Orchards, on the Saanich peninsula, are TimberWest's only seed orchards. Established in 1980 as a joint venture between Crown Forest Limited and British Columbia Forest Products, Mount Newton currently has 10 orchards for six species.

A company financial analysis identified genetic improvement on the private timberlands as a key investment area to return benefits. As a result, activities at Mount Newton focus on producing the best genetic material for TimberWest's private lands. The orchards are continually upgraded as improved clones become available, and staff are pursuing initiatives in somatic embryogenesis and rooted cuttings to increase the reforestation stock available from the best genetic material.

TimberWest is meeting or exceeding its production targets in all 1st-generation orchards, with the exception of yellow-cedar (*Chamaecyparis nootkatensis*) (see table). One of the company's 2nd-generation Douglas-fir (*Pseudotsuga menziesii*) orchards has produced seed since 1990; the second is expected to be in full production by 2004. The 2nd-generation hemlock orchard (*Tsuga heterophylla*) is due to come into production in 2002.

In addition to seed production activities, staff at the Mount Newton Seed Orchards assist the Ministry of Forests, universities, colleges, and other agencies conducting research into tree improvement, seed production, and insect and disease control.

Mount Newton has 10 orchards for six species.

Second-generation orchards for Douglas-fir and western hemlock will be producing seed by 2004.

Mount Newton Seed Orchards Information Summary

Orchard no.	Species	Area (ha)	Elevation (m)	Target plants/yr (000s)
129	Ba	6.7	225–625	758
130	Hw	0.9	300–900	375
134	Fdc	4.8	0–700	982
138	Cy	0.9	425–1200	107
140	Cw	0.2	0–625	382
152	Cw	0.2	0–625	191
154	Fdc (2nd gen.)	5.0	0–700	846
182	Hw (2nd gen.)	1.8	0–600	749
183	Fdc (2nd gen.)	2.2	0–700	372
403	Pw	1.2	0–700	n/a
Other Units				
Yellow-cedar cutting hedge				80
Hybrid poplar cutting hedge				30

Western Hemlock: A Cooperative Approach to Tree Improvement

submitted by John King and Charlie Cartwright

Western hemlock (*Tsuga heterophylla*) is British Columbia's most important coastal commercial timber species, comprising some 40% of the coastal harvest and nearly 60% of the province's export market. Hemlock wood is light coloured, has few resin canals, is straight and even-grained, has moderate bending strength, is not readily split, is easy to glue, and holds nails and paint well.

Hemlock is biologically versatile and succeeds both as an aggressive pioneer and a climax dominant from northern California to Alaska. Rapid growth rates, responsiveness to thinning, and prolific flowering make western hemlock attractive to both silviculturists and tree breeders.

The goal of hemlock tree improvement (TI) is to produce parents for seed production that can provide genetic gain for wood quality and quantity with well-adapted genotypes at appropriate costs. Because western hemlock regenerates naturally with great success, improved seed must offer sufficient benefits to help offset planting costs.

Hemlock TI activities in British Columbia have already produced such benefits as faster green-up (1–2 years) and more even stocking in artificially regenerated stands. The observed and projected gains from using improved seed further justify the choice to plant. As a result, some 8 million hemlock seedlings are planted annually in B.C.: about 5.5 million from the low elevation (<600 m) and 2.5 million from the high elevation (>600 m) on the southern coast; 0.35 million from the mid-coast Maritime region; and 0.15 million from the Submaritime zone.

Western Hemlock TI in B.C.

British Columbia embarked on hemlock TI with parent tree selection in 1959. By 1976, the province had its first full-time hemlock tree breeder and, by the 1980s, the Ministry of Forests had established a tree improvement program with two goals:

1. to finish testing 1st-generation orchards
2. to work for the acceptance of Class A (improved) seed.

When the program was reviewed in the late 1980s, the 147 parent trees tested did not produce the desired 25% volume gains with an acceptable level of diversity. However, some 1500 tested hemlock parents existed in other Pacific Northwest programs. There was clearly potential for a cooperative approach to TI that would allow collaborating agencies to capitalize on extensive investments in progeny testing and seed orchard development elsewhere.

HEMTIC

In 1991, the Western Hemlock Tree Improvement Cooperative (HEMTIC) was established with private, aboriginal, and governmental organizations from across the Pacific Northwest.

Cooperators include the U.S. Forest Service; U.S. Bureau of Land Management; Oregon Department of Forestry (ODF); Quinault Indian Nation; Willamette Industries Inc.; Simpson Timber Co.; Rayonier Inc.; Crown Pacific Ltd.; B.C. Ministry of Forests; Canadian Forest Products Ltd.; MacMillan Bloedel Ltd.; TimberWest Forest Limited; and Western Forest Products Limited.

HEMTIC's primary goal has been the construction of a filial (F_1) generation from diallel matings among 1st-generation orchard clones to provide a diverse pool of fast growing genotypes for future TI. A secondary goal has been the reselection of these parents for current use as high-gain seed orchard stock.

Estimated gains from the new orchards being established with HEMTIC material are about 17%, measured as height growth between 10 and 15 years or volume at rotation age (60 years). This estimate is already proving to be conservative—realized-gain trials indicate that early height-growth gains are at least 50% higher.

A cooperative approach to TI allows collaborators to capitalize on investments made elsewhere.

HEMTIC efforts from 1993 to 1998 focused on a breeding plan to create the F_1 population; five six-tree diallels for each of five regions (Tillamook, Willamette, Gray's Harbor, Forks, and British Columbia) were composed and crosses made. Over 300 full-sib families representing the 150 parent tree selections were planted out in two B.C. progeny tests in 1997. A second series of trials with the same material was outplanted in 1998 at five locations in B.C., one in Oregon (ODF), and one in Washington (Rayonier).

From 1996 to the present, HEMTIC has focused on testing the top six parents from each of the five regions (30 parents). These are being outplanted in a series of tests starting with four sites in British Columbia and one in Oregon (Willamette). This work will enable selection of the best parents to include in seed orchards now, rather than provide material for further breeding.

Over 1500 tested 1st-generation parents are currently represented in HEMTIC cooperators' seed orchards. This material was originally to be made available to all contributors following analysis of five–year measurements from the first series of trials. However, at a 1998 meeting in Shelton, Washington, HEMTIC decided to release materials for mutual use immediately. Consequently, three HEMTIC orchards are now established in B.C. at Saanich (Western Forest Products), Mount Newton (TimberWest), and Sechelt (Canadian Forest Products). These orchards include clones from the Washington programs and deliver over 15% gain. Seed production is expected early in the new millenium.

Since joining HEMTIC, British Columbia has established new trials to enlarge the pool of tested B.C. western hemlock parents. As well, assessment of wood density and pulp and fibre quality characteristics in older tests have led to selection of parents with superiority in those traits. A limited number of high elevation parents are being tested, and a network of provenance and realized-gain trials has also been established.

For more information on HEMTIC activities, watch for the upcoming publication *Western Hemlock Co-operative Tree Improvement* by King, J.N., Cartwright, C., and D. Cress.

Overview of Western Hemlock TI Activities in British Columbia

Year	Activity	Agency	Scientists
1959	parent tree selections	University of BC	
1966	provenance tests	Canadian Forest Service	Dick Pietsch
1970	first progeny trials	Tahsis Company	Henning Jensen Sven Rasmussen
1976	3 series of open-pollinated trials	BC Ministry of Forests	Michael Meagher
mid 1980s	tested 147 B.C. parent trees	BC Ministry of Forests	Jack Woods
1989	new trials to test parent trees	BC Ministry of Forests	John King
1991	HEMTIC forms by memorandum of understanding as a distinct unit under the Pacific Northwest Tree Improvement Co-op (PNWTIC).	BC Ministry of Forests and other industry, government, and aboriginal agencies	John King Charlie Cartwright Dan Cress
1993	review of 10 western hemlock seed orchards and seed accumulations	BC Ministry of Forests	John King Patti Brown
1992, 1994, 1996	establish hemlock realized-gain and silvicultural trials (3 series on Vancouver Island)	BC Ministry of Forests	John King Charlie Cartwright
current	establish new low elevation hemlock seed orchards	BC HEMTIC industry cooperators	John King Charlie Cartwright
	wood property screening for fibre coarseness, cell dimensions, microfibril angle, extractive content	BC Ministry of Forests, Forintek Canada Corp., University of BC, Pulp and Paper Institute of Canada	John King Charlie Cartwright Bob Daniels Simon Ellis John Hatton Paul Watson

The Soo TSA

submitted by Brian Broznitsky

The Natural Environment

The Soo Timber Supply Area (TSA) covers approximately 880 000 ha and includes the communities of Squamish, Whistler, Pemberton, and Mount Currie. The TSA has a varied geography formed by glacial, fluvial, and volcanic processes. Elevation ranges from sea level at Howe Sound to 2938 m at Bridge Peak at the extreme northwest tip of the TSA. Forty-five percent of the area of the TSA is comprised of ice fields, glaciers, and rock; 10% is made up of water bodies; and 5% has been converted to urban use, agriculture, highways, and utility transmission lines. The remaining 40% is forested with temperate rainforests and transitional interior forests (mainly coniferous trees with some deciduous species).

The prevailing westerly winds bring in moist marine air, which causes heavy rain and high snow levels on the Coast Mountain ranges. On the leeward side, the climate becomes more continental with lower precipitation, colder winters, and hotter summers. The mountain slopes around Squamish in the southwest portion of the TSA receive over 250 cm of precipitation a year—some of the highest levels in B.C.

The Soo offers a rich variety of recreational opportunities including windsurfing, hang gliding, whitewater kayaking, rock climbing, hiking, and cycling through some of the most beautiful scenery in the province. Fish and wildlife are abundant, and the area has great potential for tourism. It also boasts some of the province's best-developed year-round recreational facilities—in particular, the world-class facilities for skiing and other alpine activities at the Whistler-Blackcomb Mountain complex.

Timber Profile and Harvest Level

Of the total Crown forest area of 300 716 ha, some 109 765 (36%) constitutes the current timber harvesting landbase. The species mix in the harvesting landbase consists of Douglas-fir (51%); hemlock/ balsam (39%); and cedar, spruce, and cottonwood (10%).

In January 1996, the AAC for the Soo TSA was 506 000 m^3, down 13% from the previous AAC of 580 000 m^3. A further decrease in AAC is expected following completion of the next Timber Supply Review in 2000. Green-up and adjacency constraints have shifted harvesting to higher elevation forests with lower volumes per hectare.

The Soo TSA has temperate rainforests and transitional interior forests.

The Soo TSA has an unbalanced age-class distribution because of past harvests. About half the area is in young stands (<40 years), while old stands (>140 years) comprise about 35% of the forest area. There are relatively few stands between these ages. This age gap significantly impacts timber supply because the mature stands need to fill the harvest gap while the younger stands mature. To speed the rate at which the young stands develop, the TSA plan requires an annual program of 1000 ha of pre-commercial thinning and 1100 ha of fertilization.

Reforestation

Major species planted in the Soo TSA (in descending numbers) are Fdc, Sx, Cw, Hw, Ba, and Yc. About 1 million seedlings are planted each year on the approximately 1000 ha harvested in the TSA. The backlog planting program is currently around 100 000 trees a year, and decreasing rapidly.

The Soo TSA falls within the Submaritime (83%) and Maritime (17%) seed planning zones (SPZs). Coastal seed orchards produce 1st–generation (untested) seed for Maritime Fdc, Cw, and Hw, and for Submaritime Fdc and Sx. Where planting orchard seed is standard procedure, the contribution to the AAC is modeled by applying a 2% volume increase to appropriate yield curves.

The TSA falls within the Submaritime (83%) and Maritime (17%) seed planning zones.

A small quantity of 2nd-generation (parent trees tested) Maritime Fdc seed is now available. This seed is expected to produce volume gains of 10–12% over wild-stand seed. Second-generation Fdc seed is grown as a 1+0 PSB615A stock type and is reserved for planting on high site Fd (Fd SI_{50} of 33 m or more) lands to ensure maximum seed performance. Results are impressive—

the earliest 2nd-generation Fdc plantation was 1.8 m in height after its third growing season.

The Soo TSA participates in several provenance trials, including Maritime and Submaritime Fdc, comparisons of "interior" Sx versus local Submaritime Sx seed sources, noble fir (*Abies procera*), and comparisons of interior Fd versus local Submaritime Fdc seed sources.

The last trial is of particular interest. Planted Submaritime Fdc often has difficulties surviving on dry, south aspects on the coast–interior transitional areas in the eastern part of the TSA. This low survival rate often lengthens regeneration delay and requires herbicide site preparation before replanting. The hypothesis is that Fdi from interior wet-belt sources may be better suited to these difficult sites. If true, the higher initial survival of Fdi might offset its lower volume growth and provide similar volumes to those obtained from the more productive, but less reliable Submaritime Fdc. Measurements in the third growing season indicated that Fdi was surviving better than Fdc, and that the better-performing Fdi seedlots were equivalent in height growth to the Fdc. This trial is now in its fifth growing season.

Second-generation Maritime Fdc seed is expected to produce volume gains of 10–12% over wild-stand seed.

Ministry of Forests - Tree Improvement

submitted by Dale Draper

Over the past three years the Ministry of Forests has significantly reorganized to integrate its delivery of provincial tree improvement (TI) within the strategic framework developed by the Forest Genetics Council.

Forestry Division has created a new Tree Improvement Branch following a ministry Tree Improvement Program review under the auspices of the Chief Forester. The new branch brings together tree improvement policy and planning, the Tree Seed Centre, ministry seed orchards, Seed Orchard Pest Management, and Seed Extension Services to coordinate matters related to tree improvement. Dale Draper is the acting director of the new branch.

Research Branch has consolidated tree breeding and forest genetics research under Alvin Yanchuk, who reports on this program area to branch director Henry Benskin. Research Branch is working to strengthen linkages between genetics and other forest science disciplines such as growth and yield, silvicultural systems, and biodiversity.

Through Jack Woods, who has acted as Council's technical advisor, MOF has also contributed greatly to the development of Council's strategic and operational plans.

The ministry's main goals for TI include:

- to integrate ministry work within the strategic planning of the FGC
- to continue to provide a policy and practice environment that encourages sound tree improvement investments on Crown forest land
- to work effectively with agencies such as Forest Renewal BC in delivering an enhanced forest genetics program.

New Tree Improvement Branch coordinates TI efforts.

Research Branch focuses on tree breeding and forest genetics research.

Interior Seed Planning Zone Review

submitted by Leslie McAuley

Between 1997 and 1998, the Ministry of Forests conducted a review of seed planning zones (SPZs) in British Columbia's Interior, responding to a need to incorporate new biological information and interpretation, better use the biogeoclimatic ecological classification (BEC) system, and increase administrative efficiencies.

The review closely examined the relationships between SPZs, genetic class, seedling request ordering, transfer guideline application, and the BEC system. Both ministry and industry clients involved in planning, forest genetics, tree breeding, orchard management, and silvicultural activities participated in the review.

The review proposed two major recommendations:

1. incorporate new orchard breeding zones into the interior SPZ structure (using a species-level approach)
2. align new interior Class A SPZs with BEC units.

A new provincial SPZ model, implemented in June 1998, specifies separate SPZs for orchard (Class A) and wild-stand (Class B) seed. For orchard species, the new Class A SPZs may also describe "zones of overlap" for areas of transition where two breeding populations may be equally adapted. On the coast, the Class A SPZs share the same boundaries as the Class B SPZs. For all wild-stand species, coastal and interior, Class B SPZs (the old SPZs, in place before June 1998) remain in use.

All Class A seed and vegetative lots have been converted to the new Class A SPZs on the seed planning and registry (SPAR) system.

For SPZ maps and more information, visit www.for.gov.bc.ca/tip

The new provincial SPZ system specifies separate SPZs for Class A and Class B seed.

New Digitized Seed Planning Zone Maps

submitted by Leslie McAuley

The new interior Class A SPZs have been digitized for use in spatial data analyses and in GIS-based mapping tools. The digital map files are available as both ARC-shaped (for ARC Info software) and ministry-supported Interactive Graphic Design System (IGDS) design files and map tiles.

A stewardship agreement is currently being developed within the ministry that will identify the custodian for the updating and distribution of SPZ spatial data. In the interim, digital and plotter map files are available via the ministry's Tree Improvement Branch FTP site at:

www.for.gov.bc.ca/ftp/branches/Tree Improvement_Program/external/!publish/ SPZ Digital Map Files

For more information, contact:
Ron Planden at (250) 356.6207 or ron.planden@ gems6.gov.bc.ca).

Digital map files are available for ARC Info and IGDS software.

A Revised Ministry Surplus Seed Fee Schedule

submitted by David Reid

Note: *This article refers to seed produced in Ministry of Forests seed orchards that is declared surplus on the provincial seed planning and registry (SPAR) database. Private seed orchards remain free to establish their own price schedules.*

The Ministry of Forests announced a new price schedule for surplus forest tree seed produced in its orchards, effective June 30, 1998.

History of Seed Pricing

The price of natural stand (Class B) seed was last reviewed in 1993, when it was raised to reflect the increasing costs of collection and processing. The ministry price for surplus orchard (Class A) seed remained fixed at 1.5 times the price of Class B seed. Since the ministry Class A seed prices were not based on actual costs of production, they differed substantially from industry prices. The disparity was of particular concern in SPZs where both the ministry and industry produced Class A seed.

In 1997, members of the transitional Tree Improvement Council (TIC) agreed that the price of ministry orchard seed should not be kept arbitrarily lower than the true costs of production. A key goal of the Council's Business Plan is to increase production of genetically improved seed from the current 30% to 75% of sowing by 2007. Artificially low seed prices hinder the establishment of new orchard capacity needed to accomplish this goal. Councillors urged the ministry to revise its price schedule for surplus Class A seed.

Seed Cost Review

In late 1997, Chief Forester Larry Pedersen requested a review of the cost of Class A seed in MOF seed orchards.

The review examined five seed orchard species: Douglas-fir, western hemlock, lodgepole pine, interior spruce, and western larch.

The costs used in the review reflect ministry annual production costs and amortized capital costs from all production seed orchards over their life span. All relevant business expenses were included, and adjustments were made to account for costs paid by other departments (e.g., vehicle acquisition). Land acquisition costs were not included in the review.

Because of this review, the ministry revised its seed pricing policy and adjusted its price schedule for surplus Class A seed.
MOF staff (Operations Division) and the transitional TIC reviewed a draft of the new surplus seed price schedule in March/April 1998. No significant issues were identified, and the following surplus seed prices for MOF Class A seed went into effect on June 30, 1998. The new seed prices, which are about five times those of Class B seed, are now much closer to industry seed orchard prices for comparable material.

The new Class A seed prices are about five times those of Class B seed, and much closer to industry seed orchard prices for comparable material.

Species	Seed cost ($/kg)	Seed cost per seedling (single sow) ($/kg)	Seed cost per hectare (at 1000 trees/ha) ($/ha)
Douglas-fir: (genetic worth 2–6%)	2,000	0.054	53.54
Douglas-fir: (genetic worth ≥7%)	3,500	0.075	74.95
Interior spruce	4,000	0.020	20.30
Lodgepole pine	6,000	0.040	40.47
Western hemlock	5,000	0.023	23.11
Western larch	3,500	0.055	55.20
Average	4,000	0.040	44.60

1998 Seed Orchard Crop Information

submitted by David Reid

The following tables summarize the 1998 cone crop for coastal and interior seed orchards, as reported in the ministry's *Update Extension Note*, *vol. 3, no. 1, March 1999.*

Some figures are still estimates, awaiting final extraction or test results. The ministry will publish a final summary with current figures for all orchards in June 1999.

1998 Seed Orchard Cone Collection Summary

	Agency	Orch. no.	New seed zone	S/L	Species	HI	Genetic worth (G+__)	Actual yield (kgs)	Estimated no. of plantables
1	CFP	139	M	60672	Cw	0.6	2	0.012	2,458
2	TFL	140	M	60638	Cw	21.8	2	4.8	983,040
3	TFL	140	M	60639	Cw	3.6	5	0.52	106,496
4	TFL	140	M	60640	Cw	0.3	12	0.151	30,925
5	WFP	155	M	60356	Cw*	5.5	2	**2.75**	563,200
6	WFP	156	M	60354	Cw*	5.5	2	**2.75**	563,200
7	WFP	128	M	60353	Cw*	5	2	**2.5**	512,000
8	WFP	128	M	60355	Cw*	5	2	**2.5**	512,000
						47.3		15.983	3,273,318
9	TFL	134	M	60636	Fdc	9	7	0.78	24,186
10	TFL	154	M	60637	Fdc	11.3	8	0.948	29,396
11	TFL	154	M	60629	Fdc		n/a	0.337	priv. land only
12	WFP	166/69	M	60350	Fdc	1.5	18	0.381	11,814
						21.8		2.446	65,396
13	CFP	133	M	60379	Hw	2.2		1.985	175,450
14	CFP	133	M	60627	Hw	2	11	0.164	14,496
15	MOF	143	M	60374	Hw	3.25	2	4.554	402,519
16	WFP	126/170	M	60352	Hw	1.9	8	0.459	40,570
17	WFP	126	M	60351	Hw	0.36	16	0.537	47,464
						9.71		7.699	680,499
18	MOF	131	Sm	60602	Sx*	44.8	3	10.867	1,423,577
19	CFP	174	M	60673	Pw	0.1	R+ ?	0.536	6,992
20	MOF	175	M, Sm, GL	45203	Pw	2	R+ ?	1.441	18,796
21	MOF	175	M, Sm, GL	60392	Pw	8.6	R+ ?	5.408	70,542
						10.7		7.385	96,330
	Coast Total					**134**		**44.38**	**5,539,120**

1998 Seed Orchard Cone Collection Summary *(continued)*

	Agency	Orch. no.	New seed zone	S/L	Species	HI	Genetic worth (G+__)	Actual yield (kgs)	Estimated no. of plantables
22	MOF	332	NE, NEK	60703	Lw*	7.9	2	**4.4398**	177,592
23	MOF	333	EK, NEK	60704	Lw*	5.6	2	**3.1472**	125,888
						13.5		**7.587**	303,480
24	MOF	230	NS	60701	Pli	43.8	2	9.438	834,206
25	MOF	307	NE, PGN, TON	60702	Pli	12.3	6	1.031	91,128
26	MOF	203	PG,PGN,BVP,CPP	60215	Pli	4.2	2	1.178	179,056
27	MOF	228	BV, BVC, BVP	60216	Pli	2.3	6	1.023	90,421
28	RFP	310	TO, TON	60140	Pli	2.67	12	0.134	11,844
29	VSOC	219	BV,BVP,BVC	60120	Pli	10.98	10	0.198	17,501
30	VSOC	222	PG,BVP,CPP,PGN	60121	Pli	4.35	5	0.14	12,374
31	Weyco	308	TO	60404	Pli	37.7	6	5.477	484,101
						118.3		18.619	1,720,631
32	MOF	335	KQ	60705	Pw	1.2	R+ ?	0.175	2,283
33	RFP	303	TO, TON	60138	Sx	28.4	7	8.899	1,165,769
34	RFP	303	TO, TON	60139	Sx	0.6	11	0.263	34,453
						29		9.162	1,200,222
	Interior Total					**162**		**35.54**	**3,226,616**
	Total Coast and Interior					**296**		**79.92**	**8,765,736**
35	MOF **	332	NE,NEK	60706	Lw		2	3.2	128,000
36	MOF ***	333	EK,NEK	60707	Lw		2	3.1	124,000

* actual yield still not available
** 3.2 kg of seed from previous years for bulking
*** 3.1 kg of seed from previous years for bulking

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City: ______________ Province/State: ______________ Postal/Zip Code ________

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