National Tree Seed Centre

Annual Report

2000

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Natural Resources Canada
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INTRODUCTION

This report is the third report covering the activities of the National Tree Seed Centre (NTSC). Similar reports were prepared for 1998 and 1999. The purpose is to provide a summary of the activities of the NTSC for 2000. The report also captures the results of tests and experiments that were conducted by staff during the year in order to assure that this information is not lost.

The NTSC is a major component of the National Forest Genetics Resources Centre. It was established in 1967 at the Petawawa National Forestry Institute (PNFI) in Ontario and was transferred to the Atlantic Forestry Centre in Fredericton, New Brunswick in 1996. The mandate of the NTSC is to obtain, store, and provide seed of known origin and quality for forest research; carry out baseline research on seed of Canadian tree and shrub species; preserve germplasm obtained from rare, endangered, and/or unique populations for gene conservation.

Seed is stored in four different categories: Seed Bank, Reserved, Tree Breeding, and Gene Conservation (Table 1). The seed that was in the Provenance Test category was moved to Reserved seedlots in 2000.

Table 1. Seed stored at the NTSC as of December 31, 2000.

Seed Bank		Reserved		Tree Breeding		Gene Conservation	
# Species	# Seedlots	# Species	# Seedlots	# Species	# Seedlots	# Species	# Seedlots
212	3 669	41	1 942	34	4 460	8	1 412

Seed Bank seedlots are defined as being those that are available for distribution. One of the objectives of the NTSC is to obtain seed samples of Canadian tree and shrub species from across their natural ranges. As of December 31, 2000 the NTSC Seed Bank had 124 different Canadian species (3 245 seedlots) in storage (Table 2). An additional 107 exotic species (424 seedlots) are also stored. With the mandate of the Centre now concentrating on seed from Canadian tree and shrub species, the proportion of seed from exotic species will decrease although some opportunistic acquisitions will still be made. The majority of the seedlots in storage are from Ontario and Quebec. The high number of Ontario seedlots is primarily due to 700 single-tree white spruce seedlots from the Ottawa Valley. The number of seedlots from Quebec increased dramatically over the past year because of a generous donation from the Ministère des Ressources naturelles du Québec (Provincial Seed Centre in Berthierville). The total number of seedlots increased by 526 in 2000.

Since the Seed Centre moved to Fredericton, staff at the NTSC have concentrated their efforts in acquiring collections from New Brunswick, Nova Scotia, and Prince Edward Island. In future years, an effort will be required to collect or acquire seed from more distant locations. There is an ongoing effort to acquire seed from other provinces and Seed Centres whenever the opportunity presents itself. The NTSC needs to make an effort to increase it's number of seedlots west of Ontario. Since collections by NTSC staff are unlikely due to distance and costs, these seedlots will have to be purchased or obtained through donation.

Table 2. Number of species and number of seedlots by province stored at the Seed Bank.

Province	# Species	# Seedlots	%
Alberta	13	50	1.5
British Columbia	28	275	8.5
Manitoba	1	4	0.1
New Brunswick	60	505	15.6
Newfoundland	11	77	2.4
Nova Scotia	35	228	7.0
Ontario	64	1 156	35.6
Prince Edward Island	30	72	2.2
Québec	15	771	23.8
Saskatchewan	9	67	2.1
Yukon Territory	2	40	1.2
Total		3 245	100

The Reserved category contains seedlots that have been reserved by researchers. Many of these seedlots were collected for special projects. Some clean-up of this category is necessary but remains a low priority at this time. In 2000, the following were added to the Reserved seedlots category: 27 *Pinus rigida* seedlots (Dr. Alex Mosseler), 191 *Picea rubens* and *Picea mariana* seedlots (John Major), and 1 *Cedrela odorata* (Dr. Stewart Cameron).

The Tree Breeding category contains the largest number of seedlots. These originated from the genetics program at PNFI and were transferred to the Seed Centre for storage. Many of these have been stored in sub-optimal conditions for many years. Many of these seedlots are still being stored at 4°C. This seed is of questionable quality and must be tested before being stored at -20°C. Over time the better quality Tree Breeding seedlots are moved to the Seed Bank category as testing progresses.

The Gene Conservation category was put in place to assure that genetic material obtained from rare, endangered and/or unique populations is preserved. Preliminary criteria have been developed for inclusion in this category. Material stored will be of good quality and testing will be carried out on sub-samples of the material. Seed from the Provenance Test category was moved to this category in 2000. These seedlots were composed mainly of white spruce (1 347 out of 1 365) seedlots from the range-wide white spruce provenance collections which were made in cooperation with PNFI in the mid to late 1970's. Most of these are 5 or 10 gram quantities contained in sealed plastic packets that have been placed in large Mason jars and stored at -20°C. Many of these seedlots are also stored in the Seed Bank (-20°C) and Tree Breeding (4°C) categories.

COLLECTIONS IN 2000

The year 2000 was an excellent seed year for most tree species in the Maritime provinces. Thirty-three different species were collected in 2000 (195 collections). The majority of the collections were made in New Brunswick (153) with 25 collections coming from Nova Scotia, 8 from Prince Edward Island, and 9 from Ontario (Table 3). Methods used to collect seed ranged from picking seed directly from the tree or shrub, using a bucket truck, climbing, pole pruners, and collecting from the ground.

In 2000, the emphasis shifted from bulk collections to single-tree collections. There are several reasons for this change. Researchers often prefer single-tree collections for their research and they often require seed from several trees from the same provenance. If a bulk is required, it can easily be composed of seed from several single-tree collections made from the same area. Another observation is that seed collected from single trees from the same location at the same time do not all germinate at the same level and the decrease in viability over time is not the same.

There were several notable collections made during 2000 including a collection of hazel alder (*Alnus serrulata*) from the Saint Croix river in New Brunswick. This is the first collection of this species for the Seed Centre. The collection represents one of only two known sites of this species in New Brunswick. Seed from the other location, along the Eel river near Meductic, was not collected in 2000. An effort will be made to collect from this population.

Another species collected for the first time was northern arrowood (*Viburnum recognitum*). This is not a rare species but it had not been collected in the past. It grows mainly in southwestern New Brunswick along streams or in wet areas.

Seed from mountain paper birch (*Betula cordifolia*) was also collected. This species is difficult to distinguish from white birch (*Betula papyrifera*). However, there are morphological differences between the two species and staff is becoming more confident in identifying this species. A detailed check-list will be developed to assist staff with identification of this species in the field and in the laboratory.

A special eastern white pine collection (*Pinus strobus*) was made subsequent to a request from Jilin Province, China. The request was for a larger quantity of seed (10-15 kg) than what is usually collected and stored at the Seed Centre. Twenty-eight burlap bags were collected from a stand in Pineville, New Brunswick and brought to the Atlantic Forest Seed Centre in Kingsclear for processing.

Finally, single-tree seed collections from 3 white pine trees at two sites were made to set up a long-term storage experiment. Following processing, the seed were stored in cryogenic vials at -20°C and at -196°C (liquid nitrogen), and at 3 different moisture contents (5, 8, and 11%).

Table 3. Collections made by Seed Centre staff in 2000.

Species	N.B.	N.S.	P.E.I.	ONT	Total
Acer pensylvanicum	5	0	0	0	5
Acer rubrum	4	1	0	0	5
Acer saccharinum	10	0	0	0	10
Acer saccharum	4	0	0	0	4
Acer spicatum	2	0	0	0	2
Alnus crispa	2	1	0	0	3
Alnus serrulata	1	0	0	0	1
Betula alleghaniensis	14	8	0	0	22
Betula cordifolia	4	3	0	0	7
Betula papyrifera	11	2	0	0	13
Betula populifolia	3	0	0	0	3
Corylus cornuta	1	0	0	0	1
Fagus grandifolia	1	0	0	0	1
Ilex verticillata	1	0	0	0	1
Nemopanthus mucronatus	2	0	0	0	2
Ostrya virginiana	3	0	0	0	3
Picea abies	0	0	0	4	4
Picea glauca	2	0	0	0	2
Picea mariana	3	1	0	0	4
Pinus strobus	25	4	0	5	34
Populus balsamefera	3	0	0	0	3
Populus grandidentata	0	0	5	0	5
Populus tremuloides	20	4	2	0	26
Prunus pensylvanica	1	0	0	0	1
Prunus serotina	1	0	0	0	1
Prunus virginiana	1	0	0	0	1
Quercus macrocarpa	1	0	0	0	1
Quercus rubra	1	0	0	0	1
Thuja occidentalis	5	0	0	0	5
Tsuga canadensis	18	0	1	0	19
Viburnum cassinoides	1	1	0	0	2
Viburnum lentago	1	0	0	0	1
Viburnum recognitum	1	0	0	0	1
Total	153	25	8	9	195

In addition to collections made by NTSC staff, seed was also acquired though donation. Table 4 shows the seedlots acquired during 2000 that were not collected by Seed Centre staff.

Table 4. Seedlots acquired through donation by the Seed Centre in 2000.

Species	Origin	# Seedlots
Abies balsamea	Québec (Berthierville)	12
Larix laricina	Québec (Berthierville)	18
Picea glauca	Québec (Berthierville)	116
Picea glauca	Saskatchewan	19
Picea mariana	Québec (Berthierville)	198
Picea mariana	Saskatchewan	4
Picea rubens	Québec (Berthierville)	26
Pinus banksiana	Québec (Berthierville)	153
Pinus banksiana	Saskatchewan	19
Pinus contorta	Saskatchewan	1
Pinus resinosa	Québec (Berthierville)	59
Pinus strobus	Québec (Berthierville)	45
Thuja occidentalis	Québec (Berthierville)	3
TOTAL		673

Our largest contribution came from the Ministère des Ressources naturelles du Québec (Provincial Seed Centre in Berthierville). The Seed Centre received close to 800 seedlots of native and exotic tree species collected in Québec. All of the seedlots from native populations were tested and 630 seedlots (9 species) were stored. Some of the poorer quality seedlots were discarded as space does not permit us to store low quality seed.

Information received for the exotic species from Québec did not provide a source for the seed used in the establishment of the plantations. This information is to be provided in 2001. As this information is received, the exotic seedlots will be tested and added to the Seed Bank collection.

A donation from Saskachewan Environment and Resource management was also received. This included 19 seedlots of jack pine (*Pinus banksiana*), 19 white spruce (*Picea glauca*), 4 black spruce (*Picea mariana*), and one lodgepole pine (*Pinus contorta* var. *latifolia)*. We also received a jack pine seedlot from Prince Edward Island.

SEED REQUESTS

Although the NTSC was established in 1967, database records of seed requests are not available from 1967 to 1982. However, since 1983, the number of requests for seed has ranged from a low of 17 in 1996 to a high of 156 in 1986 and 1987 (average 92 per year) (Table 5). The number of seedlots supplied has ranged from 99 in 1996 to 1 603 in 1986 (average 764 per year). It is the policy of the Seed Centre to provide seed at no cost as long as the seed be used for scientific research. Seed is also provided on occasion to universities and other educational institutions for educational purposes and to arboretums.

Table 5. Number of requests and number of seedlots supplied by the Seed Centre since 1983.

Year	# Seed Requests (Clients)			# Seedlots		
	Canadian	Foreign	Total	Canadian	Exotic	Total
1983	54	31	85	558	214	772
1984	60	26	86	541	266	807
1985	93	30	123	1 305	298	1 603
1986	127	29	156	1 016	313	1 329
1987	137	19	156	688	177	865
1988	100	23	123	566	195	761
1989	78	20	98	427	188	615
1990	98	21	119	615	192	807
1991	72	30	102	773	120	893
1992	74	19	93	706	54	765
1993	75	16	91	564	246	810
1994	91	11	102	597	181	778
1995	44	9	53	316	116	432
1996	11	6	17	70	29	99
1997	37	15	52	655	87	742
1998	54	10	64	562	55	617
1999	47	11	58	419	69	488
2000	59	21	80	501	65	566
Average	73	19	92	604	160	764

There appears to be an increase in the number of foreign clients requesting seed and a decrease in the number of requests for seed of exotic species in recent years. Since the focus on collections is now on seed from Canadian tree and shrub species, this trend will likely continue as more Canadian species and collections are added and non-Canadian (exotic) ones become exhausted.

During 2000, a total of 80 seed requests representing 566 seedlots was processed. Most of the requests were from Canada but seed was also sent to China, Czech Republic, Falkland Islands, Finland, France, Slovakia, Switzerland, and the United States (Table 6).

Table 6. Number of requests and number of seedlots shipped by country in 2000.

Country	# Requests	# Seedlots
Canada	59	355
China	8	128
Czech Republic	1	2
Falkland Islands	2	5
Finland	1	38
France	1	1
Slovakia	1	2
Switzerland	1	2
United States	6	33
Total	80	566

Since 1983, the NTSC has shipped seed from a total of 322 different species. Many species have only been requested once or twice while others have been requested many times. Most of the requests (80%) have been for Canadian species although some exotic species stored at the NTSC have also been requested repeatedly. The species most requested are the Canadian spruces and pines (Table 7). Black spruce seed was the most requested (1 130) followed by white spruce (1 034) and red spruce (705). Among the pines, jack pine seed was requested 701 times, followed by eastern white pine (692), pitch pine (401), and red pine (350).

The hardwood seeds most often shipped were sugar maple and red maple (310 and 296 requests respectively). Alder seed were also frequently requested with mountain alder, red alder, speckled alder, and green alder all being requested in excess of 250 times. Several exotic species were also frequently requested with seed of Norway spruce and Siberian larch most requested.

Table 7. Number of requests for seed and average quantity of seed shipped to clients since 1983.

Species	Common name	Number requests	Average Quantity Shipped (g)
Abies balsamea	balsam fir	196	35.61
Abies grandis	grand fir	72	26.10
Abies lasiocarpa	subalpine fir	86	10.46
Acer pensylvanicum	striped maple	57	11.99
Acer rubrum	red maple	295	15.27
Acer saccharinum	silver maple	82	77.16
Acer saccharum	sugar maple	310	61.67
Alnus rugosa	speckled alder	298	2.90
Alnus tenuifolia	mountain alder	105	4.02
Alnus rubra	red alder	257	4.88
Alnus crispa	green alder	256	3.53
Alnus glutinosa	European black alder	98	6.56
Alnus sinuata	Sitka alder	256	3.05
Betula alleghaniensis	yellow birch	265	7.98
Betula papyrifera	white birch	203	1.93
Fagus grandifolia	American beech	102	65.76
Fraxinus americana	white ash	133	69.42
Fraxinus pennsylvanica	red ash	110	43.48
Larix decidua	European larch	120	6.82
Larix eurolepis	Dunkeld larch	74	20.91
Larix gmelini	Dahurian larch	53	2.20
Larix kaempferi	Japanese larch	106	5.53
Larix laricina	tamarack	218	5.95
Larix sibirica	Siberian larch	215	7.25
Picea abies	Norway spruce	203	11.57
Picea engelmanii	Engelmann spruce	108	4.89
Picea glauca	white spruce	1 034	15.07
Picea mariana	black spruce	1 130	5.52
Picea rubens	red spruce	705	2.34
Picea sitchensis	Sitka spruce	119	3.84
Pinus banksiana	jack pine	701	13.22
Pinus contorta var. latifolia	lodgepole pine	339	11.49
Pinus monticola	Western white pine	93	8.04
Pinus ponderosa	ponderosa pine	63	44.00
Pinus resinosa	red pine	350	29.14
Pinus rigida	pitch pine	417	4.14
Pinus strobus	Eastern white pine	692	69.61
Pinus sylvestris	Scots pine	145	12.91
Populus grandidentata	largetooth aspen	69	0.81
Populus tremuloides	trembling aspen	132	1.18
Pseudotsuga menziesii var. menziesii	Douglas-fir	124	12.63
Quercus rubra	red oak	129	3 439.98
Thuja occidentalis	Eastern white cedar	111	5.40
Tilia americana	basswood	52	35.88
Tsuga canadensis	Eastern hemlock	128	7.56
Ulmus americana	white elm	52	6.03

SEED TESTING

Germination tests are performed on all freshly collected seedlots as well as seedlots in storage that have not been tested for several years. In most cases, due to small seedlot size, four replicates of 50 seed are placed in germination trays on moistened Kimpak. When larger seed is being tested, the number of seed is reduced. Two replicates of 100 seeds are sometimes used especially when dealing with small seed. Germination testing in 2000 concentrated on white spruce seedlots and seedlots acquired through donation. **One thousand six hundred and sixty-four germination tests** were carried out in 2000.

Table 8 shows the number of tests carried out by the NTSC since 1983. Some testing was carried out prior to 1983 (1970-82), however, the number of tests conducted was low and does not represent the operations of a fully operational lab. The reduction in the number of tests between 1994 and 1996 coincides with the transferring of the Seed Centre from Petawawa to Fredericton. These figures were not used for the calculation of averages.

Once a seedlot has been cleaned, the percentage of moisture is determined. Two replicates of approx. 2 grams each (for most species) are placed in aluminum containers and placed in a convection oven at 104°C for 16 hours. Moisture content is then calculated using the formula (MC % = (Fresh Weight - Dry Weight)/Fresh Weight*100). The target moisture content for orthodox seed is between 6 and 8 percent. Seed that are above this range are further dried before being stored. **Seven hundred and seventy-six moisture content determinations** were carried out by NTSC staff in 2000.

Once moisture content is within acceptable limits, the 1000-seed weight is determined. This is carried out by counting and weighing eight replicates of one hundred seeds. When dealing with extremely small seed (birches, poplars, willows) fewer replicates are performed. When the collected sample is small (less than 800 seed), the total number of seed is counted, the total weight of the sample is determined, and the 1000-seed weight calculated. A total of **one hundred and seventy-three 1000-seed weights** were done in 2000.

Table 8. Number of germination (Germ.) tests, moisture content (MC) tests, and 1000-seed weight (TSW) tests, carried out between 1983 and 2000.

Year	# Germ.	# MC	# TSW
1983	961	1 400	992
1984	1 079	132	686
1985	2 101	744	1 758
1986	1 349	266	1 259
1987	691	73	91
1988	658	275	377
1989	517	627	543
1990	431	713	303
1991	323	176	139
1992	413	126	336
1993	793	218	708
*1994**	*0*	*0*	*0*
*1995**	*13*	*14*	*13*
*1996**	*0*	*13*	*16*
1997	702	143	425
1998	964	319	710
1999	900	380	331
2000	1 664	776	173
Average	870	425	589

* *The figures for these years are not included in the calculation of averages.*

Red Oak Storage Experiment I

The 1999 Annual Report presented 6 and 12 month results from undergraduate student Lori Burry's BscF thesis. When this experiment was set-up enough acorns were stored to allow for additional sampling at 18 and 24 months.

Acorns were collected in 1998 from three trees at one week intervals for three weeks. Acorns were stored in glass jars and invigoration tubes with and without peat. The glass jars were 1 litre Mason jars while the invigoration tubes were pieces of 10 cm diameter PVC pipe 30 cm long. Gore-tex was used to cover both ends of the invigoration tubes and the mouth of the jars.

Moisture content and germination of the acorns declined over time with the greatest decrease for the acorns stored in the invigoration tubes. After 12 months, germination of acorns stored in invigoration tubes with peat was 17 % while those in tubes without peat was 2.3 %. Moisture content of the acorns declined rapidly probably because the tubes were not completely full and moisture could escape through the Gore-tex on both ends of the tube. Tables 9 and 10 show results for acorns stored in glass jars over a 24 month period.

Table 9. Germination (Germ) and moisture content (MC) (%) of red oak (*Quercus rubra*) acorns stored in glass jars without peat after 0, 6, 12, 18 and 24 months.

	0 months	6 months	12 months	18 months	24 months
Germ.		87.0	54.8	36.0	7.2
MC	41.2	39.3	34.5	29.6	28.5

Table 10. Germination (Germ) and moisture content (MC) (%) of red oak (*Quercus rubra*) acorns stored in glass jars with peat after 0, 6, 12, 18 and 24 months.

	0 months	6 months	12 months	18 months	24 months
Germ.		100.0	48.4	64.8	20.5
MC	41.2	46.6	42.3	37.9	36.0
MC peat	73.4	34.1	38.7	33.7	33.7

Clearly the acorns stored with peat had a higher germination and moisture content.

Red Oak Storage Experiment II

Another experiment was set-up in 1999 using acorns collected from the same site as the previous study. The purpose of this experiment was to evaluate the effect of freezing, test another storage container and assess the effect of another type of material covering the mouth of jars. Acorns were collected in mid-September 1999 from 3 individual trees. Acorns were stored at 4°C and -2°C. Four mil thick polyethylene bags and 500 ml Mason jars were used. The mouths of the jars were covered with either Gore-tex or parafilm. The experiment was set-up to allow sampling every 6 months for 36 months. Results presented here are for 6 and 12 months (Figure 1).

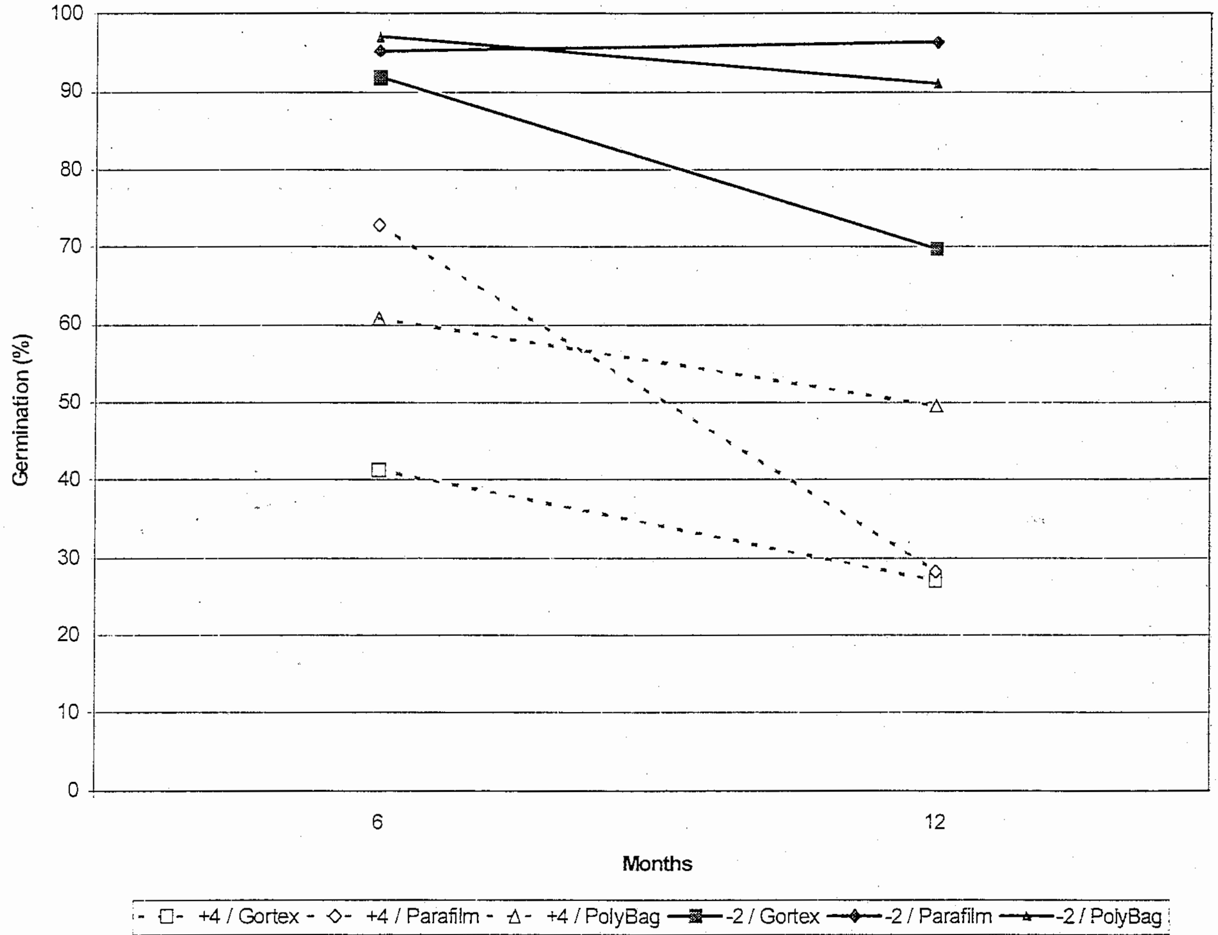

Figure 1. Germination of red oak (*Quercus rubra*) acorns stored in several containers at 4°C and -2°C.

The graph shows that acorns stored at -2°C germinated better than those stored at 4°C. Acorns stored in jars covered with Gore-tex had the lowest germination. Interestingly, moisture content of the acorns has continued to increase in all storage containers and at both temperatures since storage. The increase was as high as 8 %. Moisture content after 12 months storage for most of the seedlots averaged 37%.

Seed Germination Curves

Over the years the NTSC has accumulated a large amount of seed germination data. Time was spent synthesizing and summarizing it for a number of species (Figures 2 - 15). These graphs will be updated as seedlots are periodically re-tested. Each graph consists of two curves. The **All Seedlots** contains data on all seedlots regardless of their performance. Germination values for a particular year could range from 0 to 100. **Best Seedlots** contains data from seedlots that had germination values above arbitrary minimum values. These minimum values varied by species. These curves would represent the minimum degradation one could expect.

The seedlots from which the data were generated are all part of the Seed Centre's active inventory. As such, many of them would have been removed from storage a number of times to provide seed for clients and for testing. Thawing, opening the containers and re-freezing the seed is certain to have an impact on its long-term survivability. Therefore, it is anticipated these results represent the lower threshold of what is possible when storing seed long-term with infrequent withdrawals.

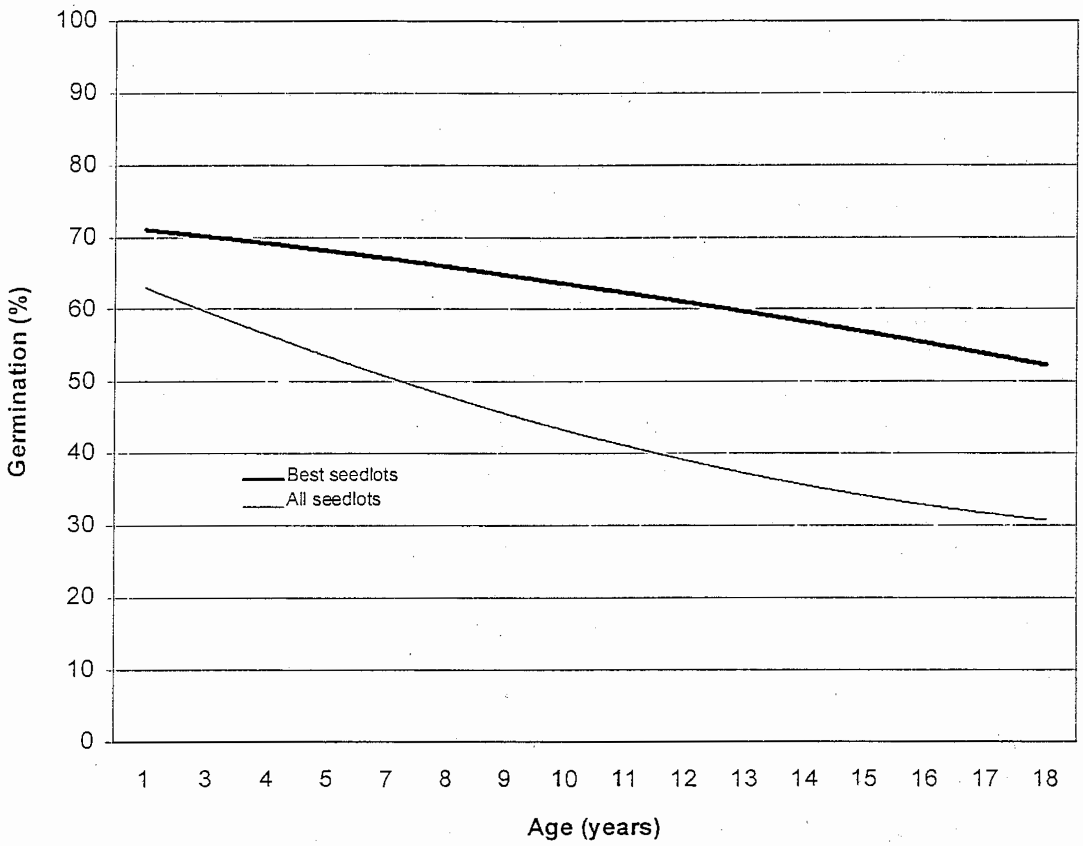

Figure 2. Germination of balsam fir (*Abies balsamea*) seed.

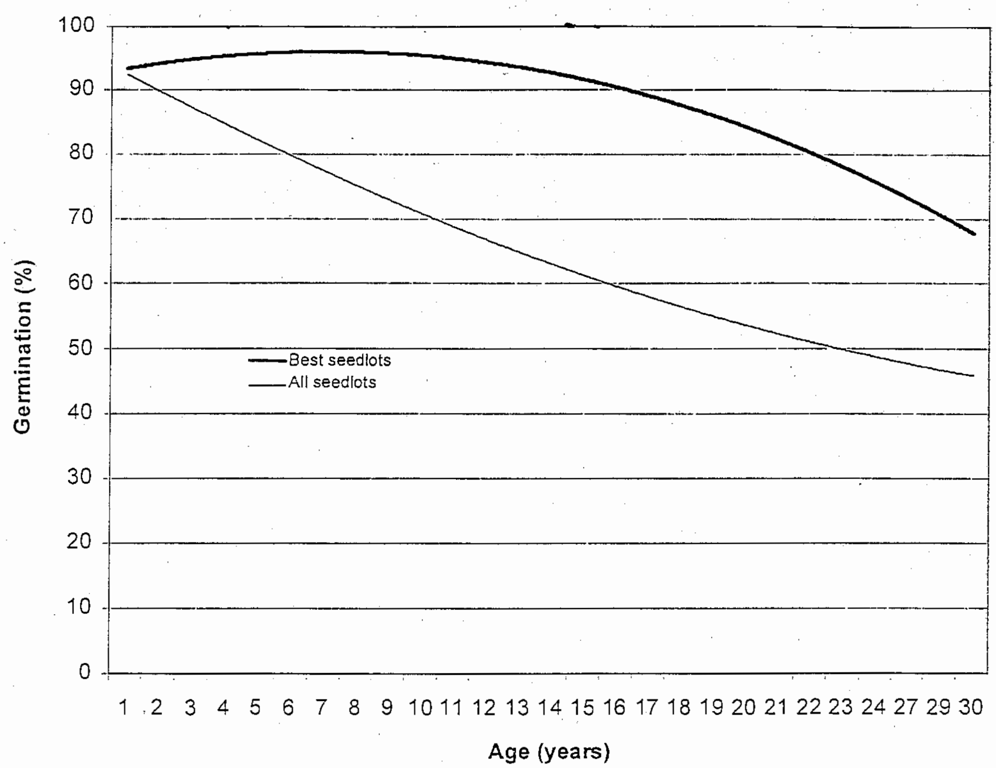

Figure 3. Germination of white spruce (*Picea glauca*) seed.

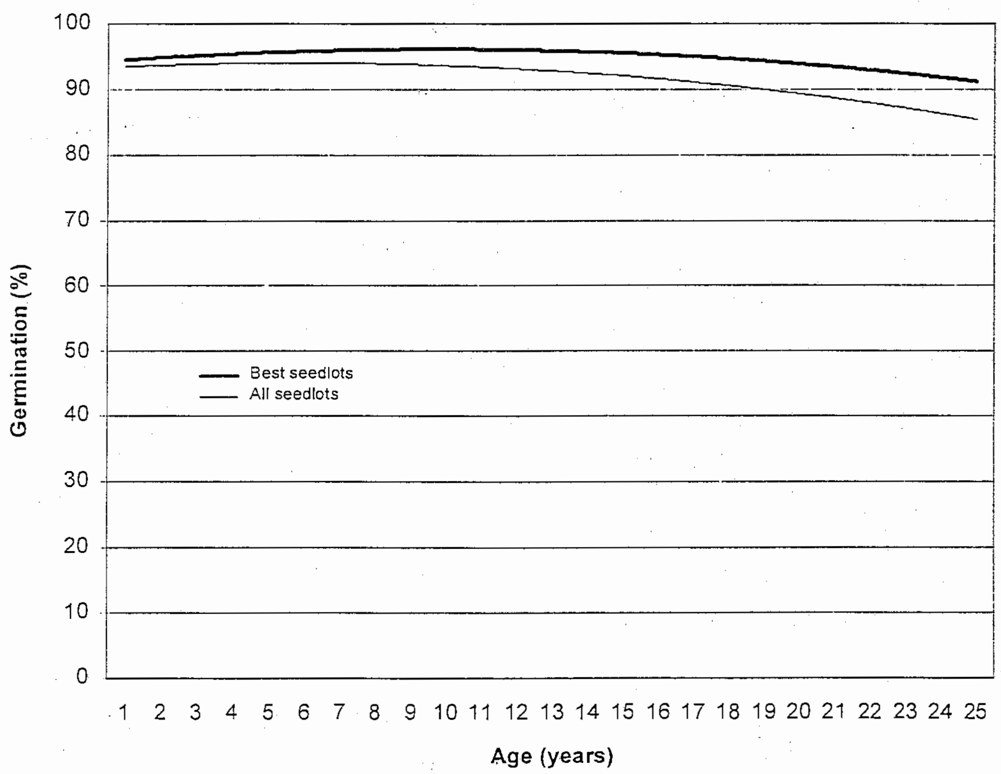

Figure 4. Germination of black spruce (*Picea mariana*) seed.

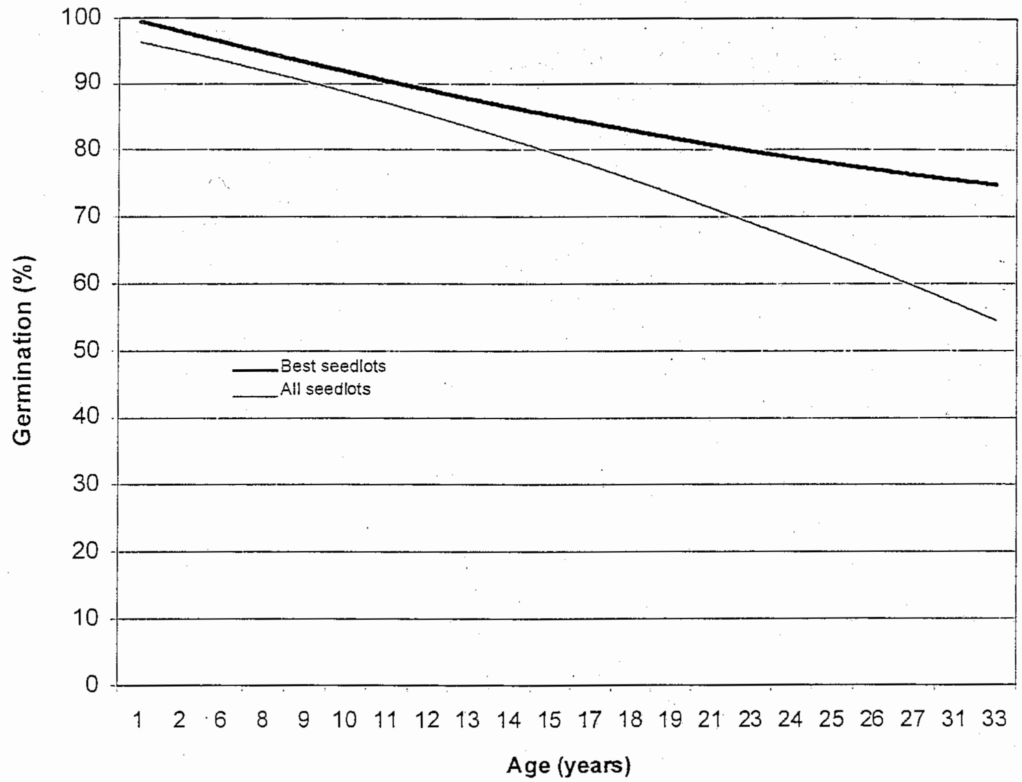

Figure 5. Germination of red spruce (*Picea rubens*) seed.

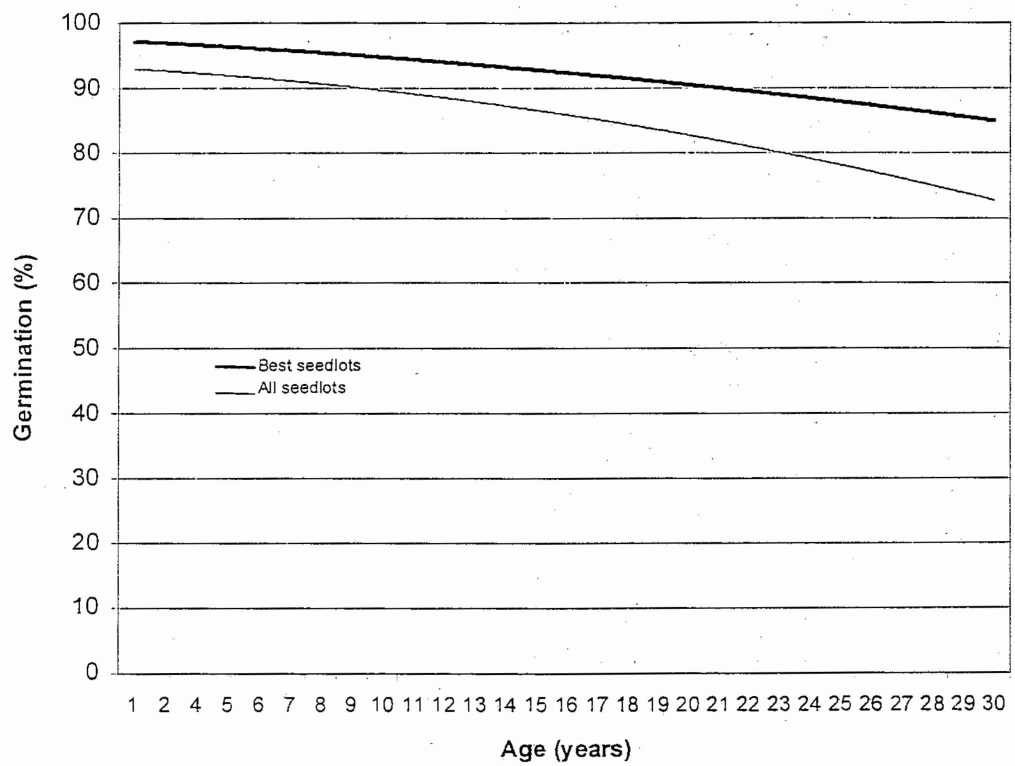

Figure 6. Germination of jack pine (*Pinus banksiana*) seed.

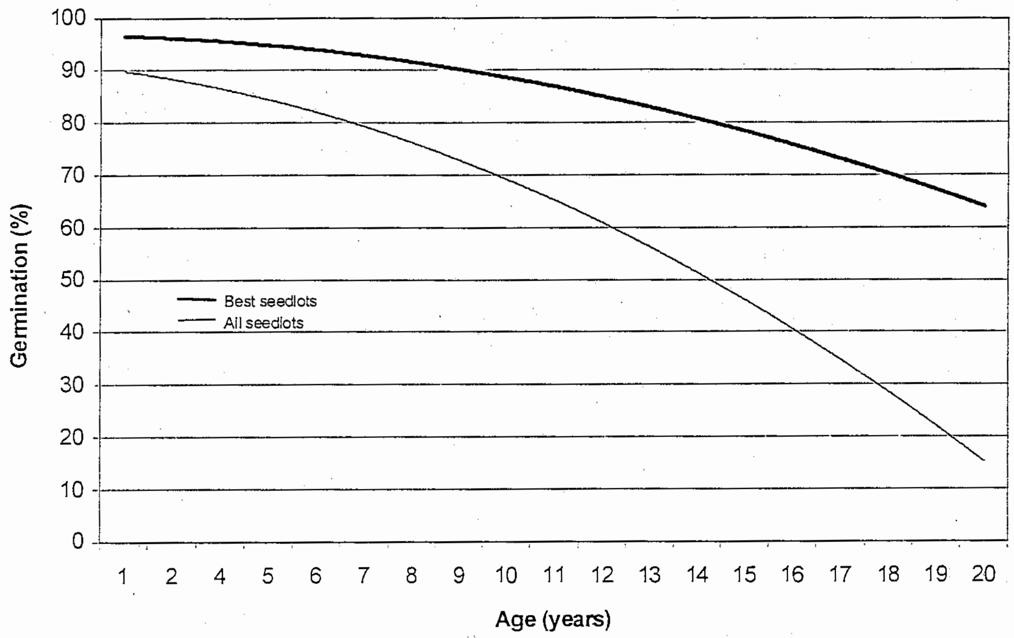

Figure 7. Germination of white pine (*Pinus strobus*) seed.

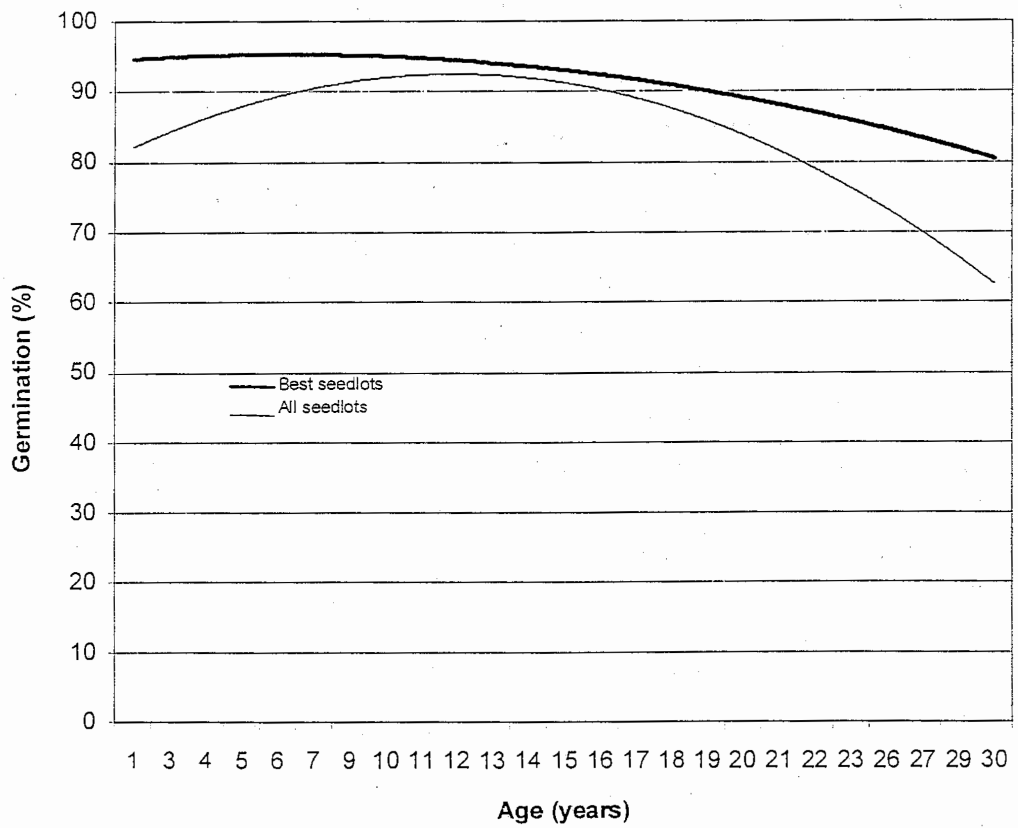

Figure 8. Germination of red pine (*Pinus resinosa*) seed.

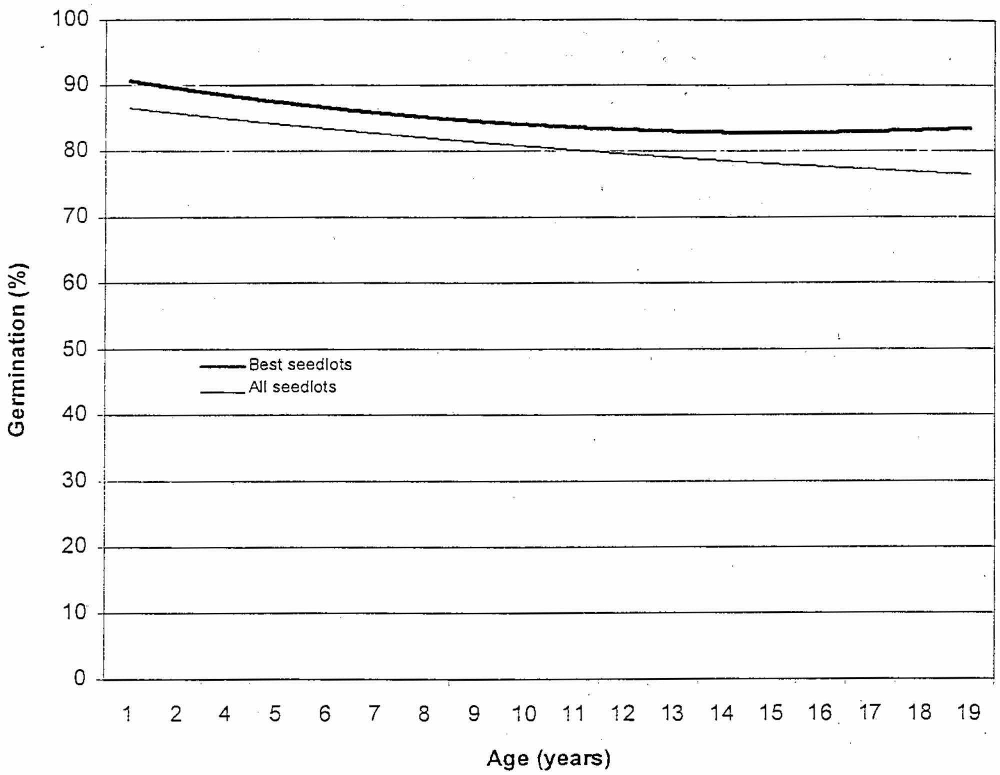

Figure 9. Germination of lodgepole pine (*Pinus contorta* var. *contorta*) seed.

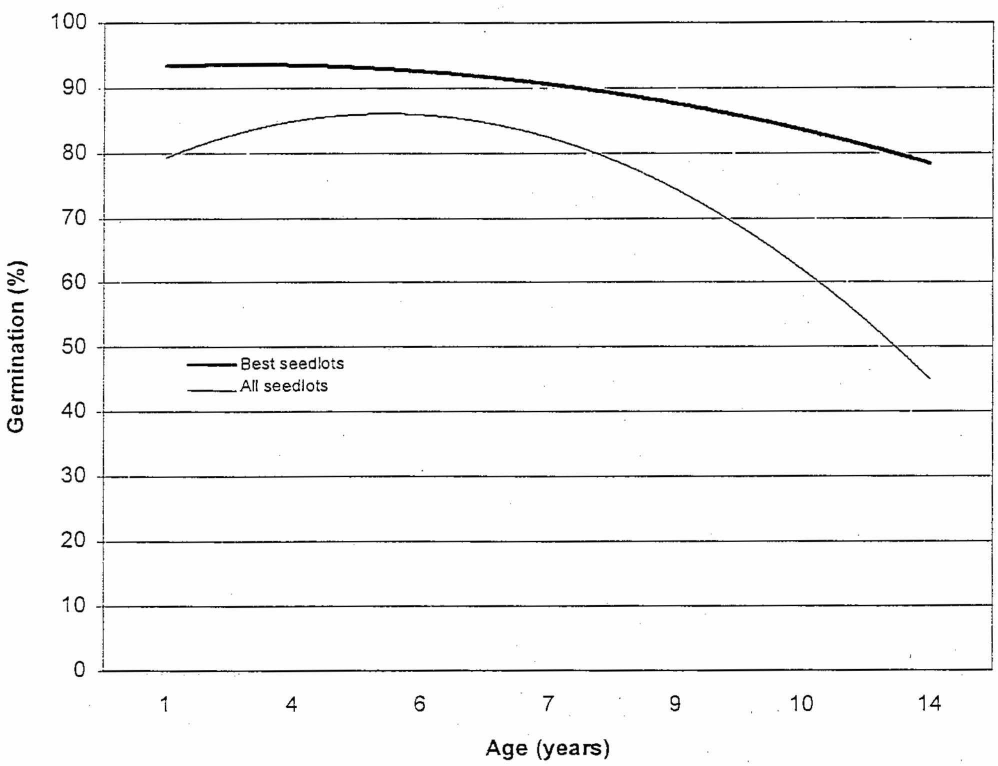

Figure 10. Germination of tamarack (*Larix laricina*) seed.

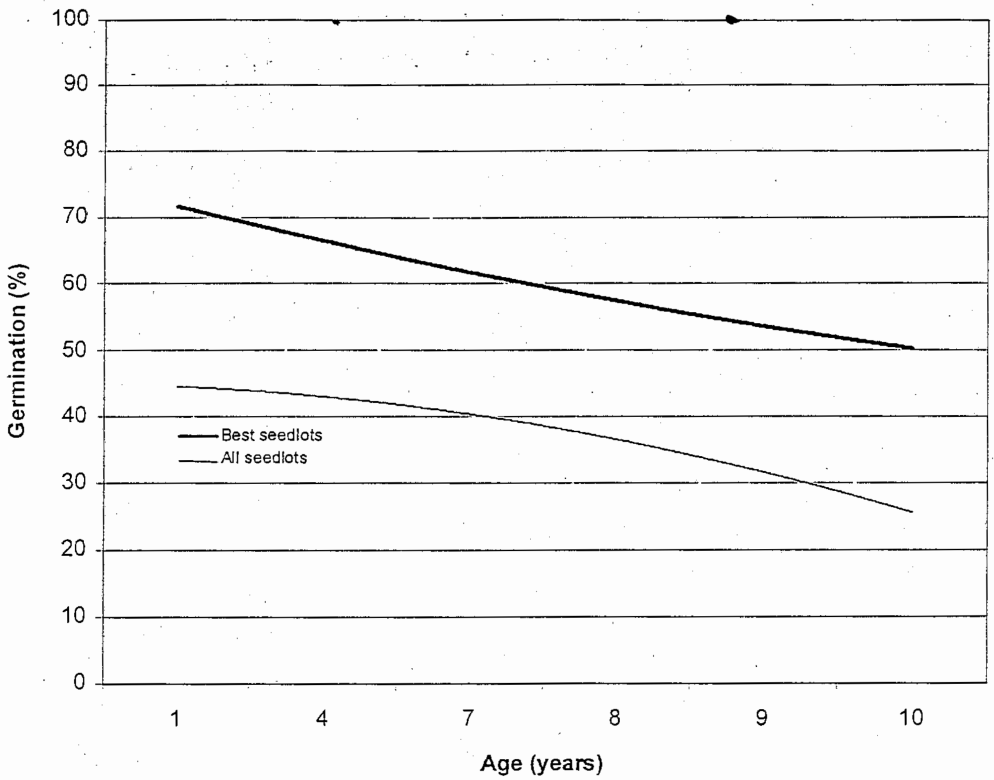

Figure 11. Germination of white birch (*Betula papyrifera*) seed.

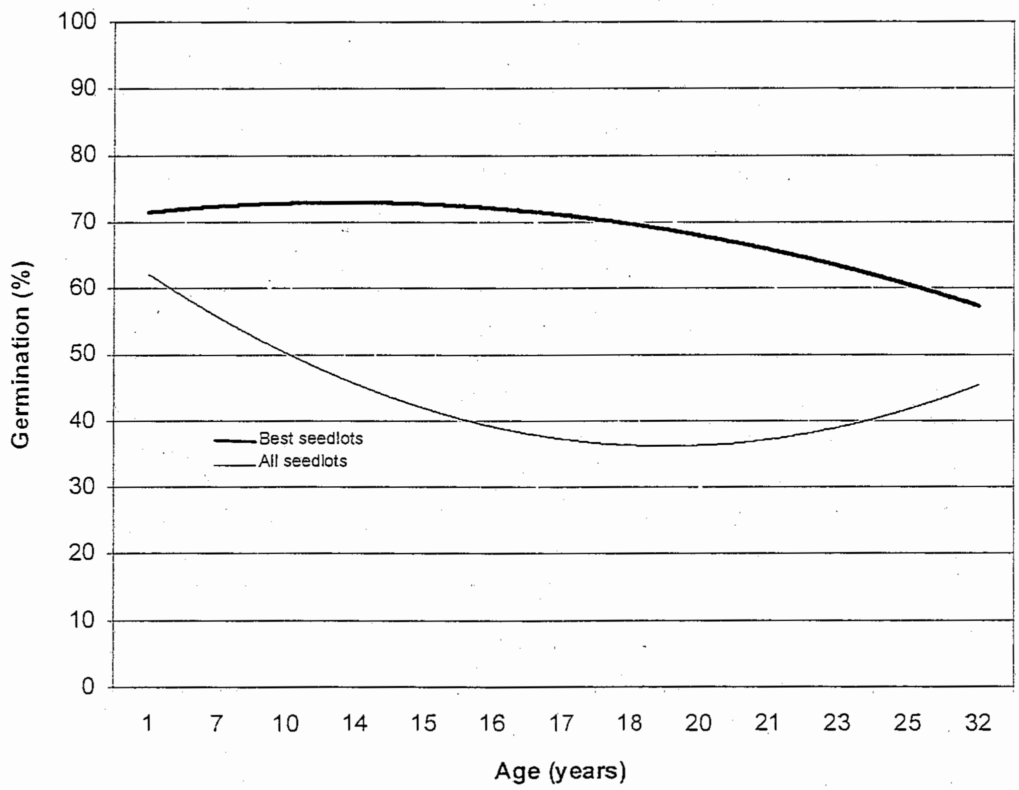

Figure 12. Germination of yellow birch (*Betula alleghaniensis*) seed.

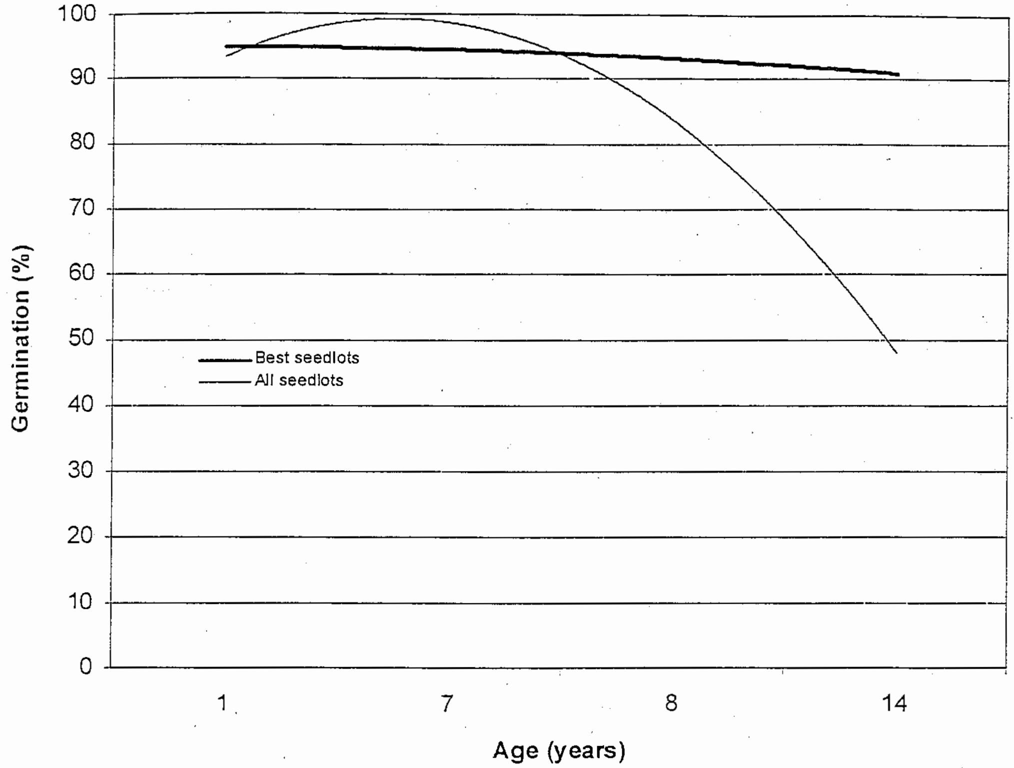

Figure 13. Germination of largetooth aspen (*Populus grandidentata*) seed.

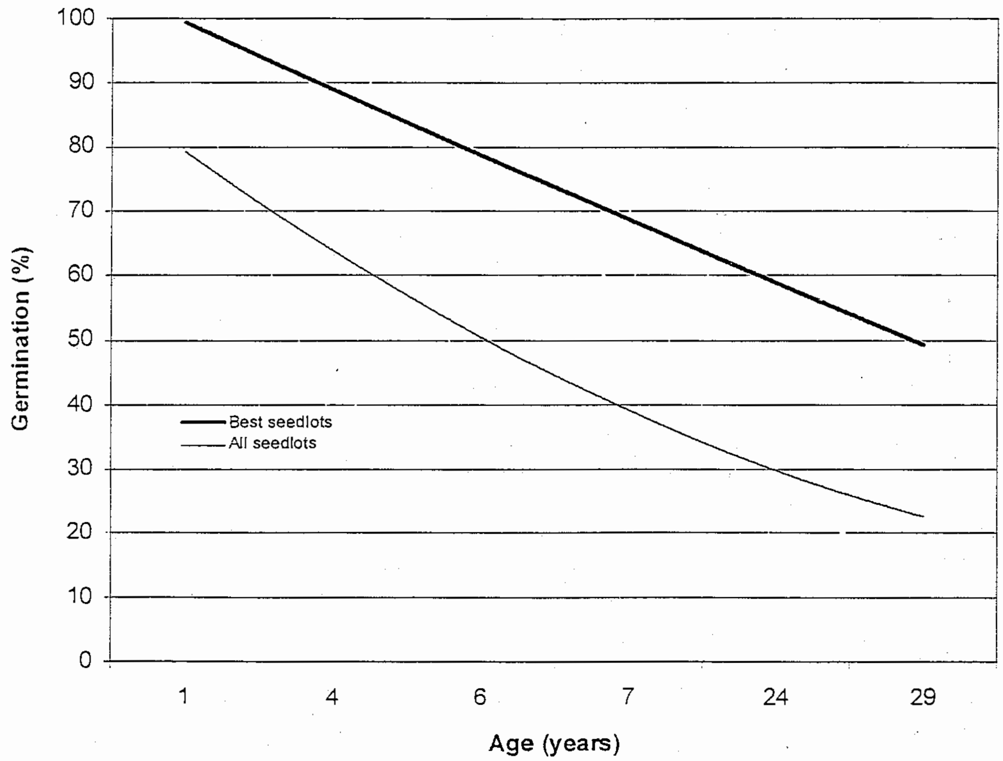

Figure 14. Germination of trembling aspen (*Populus tremuloides*) seed.

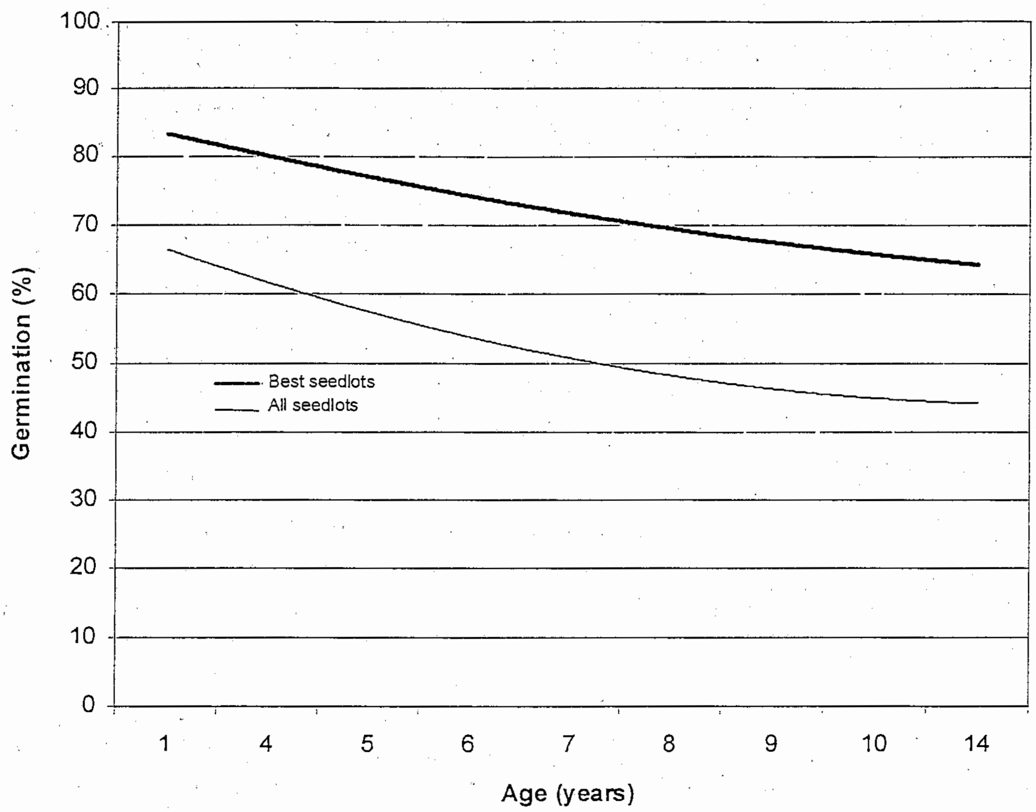

Figure 15. Germination of red maple (*Acer rubrum*) seed.

Seed Imbibition Trial

A study of seed imbibition in germination dishes was carried out in three laboratories: Alberta Land and Forest Service Seed Centre (AB), BC Ministry of Forests Seed Centre (BC), and Canadian Forest Service, National Tree Seed Centre (NB) with two germination dish types (PNFI and WEST). The objective of the trial was to investigate the uptake of moisture in the two germination dishes commonly used in Canada. Many facilities do not soak seed prior to stratification or germination testing and the time required for moisture uptake in dishes was not well documented. Information on the distribution of the variance across the remaining random factors should also allow for improvements in testing efficiency. The moisture status of seed imbibed in germination dishes was also compared to seed soaked in vials for 24 hours.

The study was conducted on two species: interior lodgepole pine (*Pinus contorta* Dougl. ex Loud. var. *latifolia* Engelm.) and white spruce (*Picea glauca* (Moench) Voss). Results are presented separately for each species. The trial incorporated four seedlots of each species. The two germination dishes were prepared at all labs according to procedures used in BC (West dishes) and AB and NB for PNFI dishes.

Seed was counted into 100-seed replicates and initial fresh weight was measured and recorded. Replicates were randomly assigned to dish type and position at each laboratory and unimbibed seed spread onto each dish (or position within dish for PNFI dishes) so that adjacent seeds were not touching. Seed was removed from the dishes and weighed at intervals of 24, 48, 72, and 96 hours and promptly returned to the dish after weighing. After the 96–hour measurement the seed was surface dried to provide an estimate of internal moisture content. After final measurements were recorded the seed was placed into a convection oven at 103° C for 17 hours to obtain the oven-dry weight of seed.

The moisture content (MC) was calculated using the fresh weight at each time interval and the final oven-dry weight. Due to differences between seedlots in initial seed moisture content the variables to be analysed will be the amount of moisture taken up after 24, 48, 72, and 96 hours (i.e. MC after 24 hours imbibition minus initial MC).

For each seedlot an additional four replicates were weighed and then imbibed in vials for 24 hours. The seed was then drained to remove excess moisture, weighed and placed into a convection oven at 103° C for 17 hours and then weighed to determine the oven-dry weight. Moisture content of seed was then calculated.

To examine the significant Lab*Dish interaction, the average for all time periods (24 to 96 hours) was averaged and plotted by dish type over all three labs for lodgepole pine (Figure 16) and white spruce (Figure 17). Data on surface dry seed, after 96 hours imbibition, are not included in these averages as the interaction was not significant for this variable.

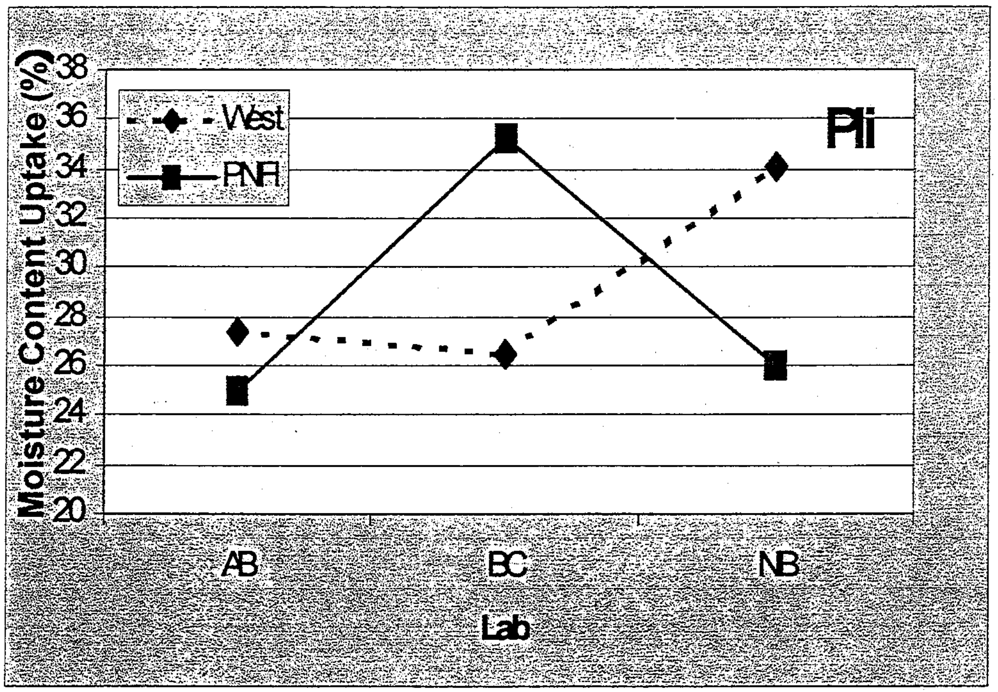

Figure 16. Graphical representation of the Lab*Dish interaction, averaged over all imbibition times, for lodgepole pine.

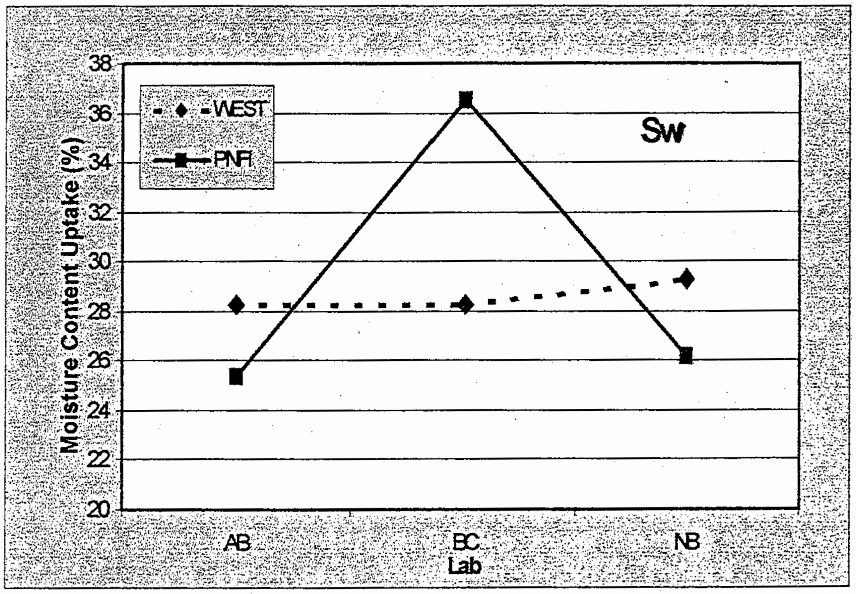

Figure 17. Graphical representation of the Lab*Dish interaction, averaged over all imbibition times, for white spruce.

The moisture uptake curves for lodgepole pine and white spruce for each lab are presented in Figures 18 and 19, respectively. Imbibition from germination dishes was rapid reaching levels of approximately 30 to 35% after 24 hours. The corresponding moisture contents following 24-hour vial soaking were 36.8% for lodgepole pine (lab estimates ranged from 34.3 to 38.7%) and 35.7% for white spruce (ranging from 33.6 to 38.6%).

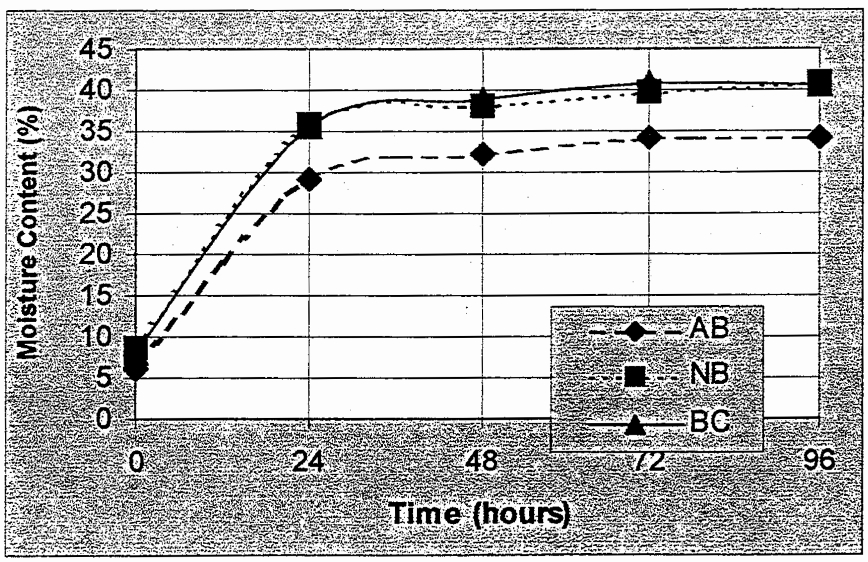

Figure 18. The moisture uptake curves for lodgepole pine over all three laboratories.

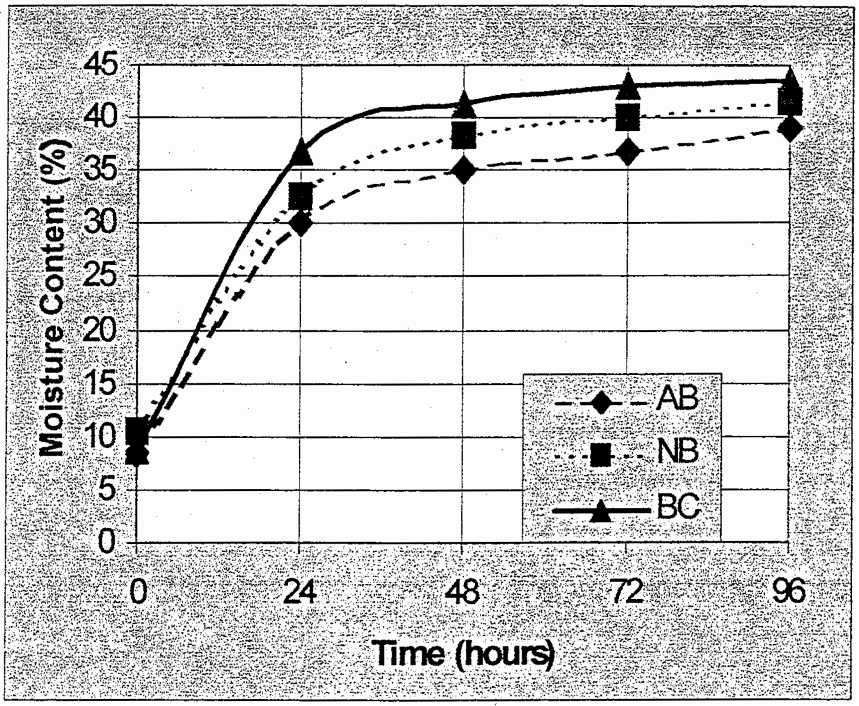

Figure 19. The moisture uptake curves for white spruce over all three laboratories.

The Lab effect was statistically significant for both species at all time intervals (including surface dried seed). The Dish effect was not statistically significant, but the interaction of the Lab*Dish was significant for all time intervals that did not incorporate surface drying. A further examination of this interaction showed that for lodgepole pine the interaction was mainly the result of high moisture contents in the BC lab for PNFI dishes and high in the NB lab for WEST dishes (Figure 16). These dishes are not the regular dishes used in the respective labs and this is the probable reason for the interaction. For white spruce the Lab*Dish interaction seemed solely caused by the high moisture content for the PNFI dish at the BC lab.

For lodgepole pine the average moisture content for the WEST dish was 29.3% and 28.7% for the PNFI dish. For white spruce, the average moisture content for the WEST dish was 28.6% and 29.3% for PNFI dishes. These differences are relatively small compared to lab differences presented in Figures 17 and 18. Laboratories can provide quite different estimates of moisture content using very similar techniques. This is partly explained by familiarity with certain techniques and the difficulty in quantifying something that is changing: the moisture content of the seed as it equilibrates to ambient conditions.

The amount of moisture imbibed by seed from the media after 24 hours was slightly lower than that of seed soaked for 24 hours in vials. The moisture content of seed after 24 hours is adequate to initiate dormancy breaking mechanisms and the imbibitional delay is considered not important from a practical point-of-view. The BC lab currently soaks seed prior to testing and for lodgepole pine and white spruce it appears that this step can be eliminated and the seed allowed to imbibe moisture directly from the media. This would also allow for the use of the seed vacuum to count and place seeds into germination dishes. Prior to changing the methodology in the BC lab, the imbibitional delay will need to be quantified for other species routinely tested in BC.

White Ash Germination Experiment

Daniel Knox, an undergraduate student in Forestry at the University of New Brunswick completed his thesis evaluating the effets of several treatments on germination of white ash (*Fraxinus americana*) seed. Dormancy, commonly associated with ash, consists of two types: internal and external. Internal is caused by the embryo and external is attributed to the seed coat and pericarp.

Seedlots in storage for 22 years at 4°C and -20°C, and 1 year at -20°C were evaluated for viability by excising embryos, placing them in germination boxes on Kimpak and putting the boxes in a germinator for 21 days. Four seedlots from each storage and temperature category with the highest viability were chosen. Seed was subjected to 4 treatments: control, pericarp removed, soak in 3 % hydrogen peroxide (H_2O_2), and pericarp removed plus soak in H_2O_2. One hundred seed from each seedlot and treatment was placed in a germination box. The boxes were placed at room temperature for 2 months followed by 5 months in a 4°C cooler, then moved to the germinator for 2 months.

Twenty-two-year-old seed stored under frozen conditions germinated better than seed that was not frozen. Removal of the pericarp dramatically improved germination for seed stored at both temperatures (Table 11).

Comparing germination of 1- and 22-year-old seed stored at -20°C, the older seed had higher germination and again germination was improved by removal of the pericarp (Table 12). The evidence suggests that dormancy is caused by the pericarp which when removed results in a substantial improvement in germination.

Table11. Germination (%) of 22-year-old white ash seed stored at 2 temperatures and subjected to 4 treatments.

Treatment	4°C	-20°C
Pericarp intact	9 %	27 %
Pericarp removed	59 %	75 %
Pericarp intact plus H_2O_2	18 %	35 %
Pericarp removed plus H_2O_2	64 %	78 %

Table12. Germination (%) of 1- and 22-year-old white ash seed stored at -20°C and subjected to 4 treatments.

Treatment	1 year old	22 year old
Pericarp intact	21 %	27 %
Pericarp removed	62 %	75 %
Pericarp plus H_2O_2	15 %	35 %
No pericarp plus H_2O_2	66 %	78 %

Beech Germination Experiment

Germination of American beech (*Fagus grandifolia*) seed requires moist chilling at 4 °C for several months. As with many other hardwood species, mold is sometimes a problem. This experiment examined four different treatments to determine if control of the mold will increase germination of beech seed.

Four seedlots were germinated using four different pre-treatments: control; soak in 2.5 % Daconil (fungicide) solution for 10 minutes followed by rinse in tap water; soak in 10 % bleach solution for 10 minutes followed by rinse in tap water; and 0.25 % Daconil which was applied using a spray bottle on day 1 and as required throughout the duration of the experiment.

Two replicates of 25 seed each were placed of moistened Kimpak in germination boxes for each of the seedlots and treatments and placed in a cooler at 4 °C for 12 weeks. The seedlots treated with the Daconil spray were assessed periodically to determine if additional spray was required. After 12 weeks, the seed were placed in a germinator set at 20 °C for 16 hours dark followed by 8 hours at 30 °C light.

The average germination of the different seedlots ranged from 0 % to 64 % and the amount of mold varied from light (L) to heavy (H) between seedlots and treatments (Table 13). The control and bleach soak treatments did not control mold although there was a difference in the mold species present in both treatments. The results of the Daconil soak and Daconil spray were equally successful in controlling mold. There was very little difference between the pre-treatments indicating that the mold species present did not affect germination of the beech seed.

Table13. Germination (%) and amount of mold for American beech (*Fagus grandifolia*) subjected to 4 pre-treatments.

Seedlot	Control		Daconil Soak		Bleach Soak		Daconil Spray		Average
	Germ.	Mold	Germ.	Mold	Germ.	Mold	Germ.	Mold	Germ.
8830126	0.0 %	H	0.0 %	L	0.0 %	H	0.0 %	L	0.0 %
9610010	0.0 %	H	4.0 %	L	0.0 %	H	2.0 %	L	1.5 %
9910120	8.0 %	H	18.0 %	L	6.0 %	H	4.0 %	L	9.0 %
9910121	72.0 %	L	66.0 %	L	60.0 %	L	64.0 %	L	64.0 %

L Light mold
H Heavy mold

The germination conditions of 20 °C for 16 hours dark followed by 8 hours at 30 °C light are not recommended for beech. Germinating the seed at cooler temperatures may have yielded better results.

White Spruce Moist Chilling Experiment

Thirty-six white spruce (*Picea glauca*) seedlots were subjected to a double test using 3- and 6-week moist chilling treatments. Seedlots selected for the test were collected between 1953 and 1967. The purpose of the test was to determine if longer stratification would increase germination for older seedlots.

Four replicates of 50 seed each were placed on moistened Kimpak in germination trays and placed in a cooler at 4° C for 3 and 6 weeks. Following stratification, the seed were placed in a germinator at 20°C for 16 hours dark and 30°C at 8 hours light for an additional 3 weeks. Germinated seeds were assessed and classified as high vigor and low vigor (Table 14).

Prechilling for 6 weeks had very little effect on successful germination of the seed (average of 32.5 % germination compared to 31.1 % for seed stratified for 3 weeks). The percentage of low vigor germinants was greater for the seed stratified for 3 weeks (average of 3.7 % vs 0.7 %). The average total germination (high vigor + low vigor) was higher for the seed stratified for 3 weeks (34.8 % vs 33.2 %).

Table 14. Germination (%) of white spruce (*Picea glauca*) seedlots moist chilled for 3 and 6 weeks at 4°C.

Seedlot	Moist Chill (3 weeks)		Moist Chill (6 weeks)	
	High Vigor (%)	Low Vigor (%)	High Vigor (%)	Low Vigor (%)
5310010.0	24.5	4.5	31.5	4.0
5530010.0	8.0	2.5	12.0	0.0
5620220.0	0.5	0.5	2.5	0.0
5620290.0	9.5	2.0	10.5	1.0
5624560.0	5.0	1.0	7.0	1.0
5624690.0	27.5	8.0	30.5	1.0
5624720.0	12.0	5.0	11.0	0.0
5624840.0	3.5	3.5	5.5	0.5
5624850.0	8.0	3.5	6.0	3.5
5630000.0	14.0	6.0	13.0	0.5
5630260.0	63.0	5.0	66.0	2.0
5630270.0	3.5	7.0	6.5	1.5
5630300.0	1.0	3.0	4.5	0.0
5810010.0	58.0	3.5	62.0	0.5
5938700.0	6.5	2.5	6.0	0.0
6016940.0	50.5	4.5	50.5	0.0
6030480.0	19.0	15.5	32.0	1.5
6530740.0	7.0	2.5	8.0	0.0
6530760.0	42.0	2.0	45.5	1.5
6531000.0	5.5	7.0	1.5	0.0
6630010.0	16.0	1.5	19.5	0.5
6630020.0	18.0	3.0	10.5	0.0
6632390.0	15.5	4.0	27.0	2.0
6730660.0	16.0	5.5	21.0	1.0
6730670.0	37.0	3.0	48.0	0.0
6730680.0	75.5	1.0	72.0	0.0
6730690.0	88.5	1.0	91.5	0.0
6730700.0	33.0	5.5	25.5	0.0
6730710.0	71.0	0.0	63.0	0.5
6730740.0	33.0	3.5	35.0	1.5
6730750.0	53.0	8.0	65.5	1.5
6730760.0	47.5	5.0	47.5	0.5
6730800.0	25.0	1.0	23.0	0.0
6730830.0	66.5	0.5	68.0	0.0
6731000.0	72.5	1.5	70.5	0.0
6731020.0	81.5	0.5	69.5	0.5
Average	31.1	3.7	32.5	0.7

De-winging of Birch Seed

Birch seeds, because of their wings and small size, are extremely light and occupy considerable storage space. In 1998, the Seed Centre acquired birch seed from British Columbia. The seed had been de-winged and the germination results were on average better than birch stored at the Seed Centre.

In 2000, several collections of white birch (*Betula papyrifera*), gray birch (*Betula populifolia*), and mountain paper birch (*Betula cordifolia*) were made. These collections were processed without de-winging and germination tests performed. Five larger seedlots were selected and half the seed was de-winged by rubbing in a cloth bag, sieved, and subjected to a light blowing in the air aspirator. Germination tests were also performed on these seedlots. The germination test results were quite variable but the de-winged seed performed better.

Based on these results, 23 seeedlots were de-winged and subjected to a more intensive blowing. Even after being de-winged the seed are sensitive to blowing and the process must be done gradually and samples must be taken throughout the process in order to examine the seed under a dissecting microscope to determine the percentage of filled seed.

The blowing will remove the crushed wings, seed that have been chewed by insects, and seed that had not fully developed. Using sieves can further clean the sample by removing scales and bracts and seed that are insect infested. These latter seed are often much larger and contain larvae that have not yet exited the seed.

All of the seedlots showed an increase in germination following de-winging. In some cases, the increase was substantial (up to 8 times greater). The average weight of the seed also increased in all but four of the seedlots (Table 15).

Although the de-winging process is time consuming, the advantages in seed quality, and the smaller storage volumes make this a very useful treatment. It will be interesting to see how well the seed will store over time. One possible problem is that the de-winging process could damage the seed. A possible advantage is that the reduced air space in the containers could provide a more favorable storage condition.

Table 15. Germination results (Germ. %) and 1000-seed weight (TSW) (g) for winged and de-winged birch seedlots.

Species	Seedlot #	Winged Seed		De-winged Seed	
		Germ.%	TSW	Germ.%	TSW
Betula cordifolia	20001066.0	27.0	.33	80.0	.54
Betula cordifolia	20001067.0	46.0	.37	88.0	.42
Betula cordifolia	20001069.0	84.5	.61	87.5	.57
Betula cordifolia	20001097.0	25.0	.37	62.0	.50
Betula cordifolia	20001110.0	33.5	.43	66.0	.57
Betula cordifolia	20001111.0	44.5	.34	96.0	.46
Betula cordifolia	20001112.0	79.5	.39	88.5	.39
Betula papyrifera	20001068.0	25.5	.12	66.0	.19
Betula papyrifera	20001071.0	41.0	.21	95.5	.28
Betula papyrifera	20001072.0	58.5	.31	61.5	.30
Betula papyrifera	20001073.0	47.5	.36	89.5	.41
Betula papyrifera	20001074.0	61.5	.28	81.5	.31
Betula papyrifera	20001075.0	42.5	.47	93.5	.68
Betula papyrifera	20001076.0	21.5	.25	48.5	.22
Betula papyrifera	20001077.0	19.5	.25	93.5	.42
Betula papyrifera	20001079.0	55.5	.36	66.0	.38
Betula papyrifera	20001094.0	47.0	.19	70.0	.20
Betula papyrifera	20001098.0	6.5	.12	49.0	.22
Betula papyrifera	20001108.0	11.0	.21	78.5	.33
Betula papyrifera	20001109.0	11.0	.17	90.0	.33
Betula populifolia	20001065.0	32.5	.14	52.0	.17
Betula populifolia	20001070.0	22.0	.08	62.5	.12
Betula populifolia	20001078.0	27.0	.09	69.5	.15

Striped Maple Germination Experiment

The International Seed Testing Association (ISTA) standards do not provide germination guidelines for striped maple (*Acer pensylvanicum*). Most maple species are moist chilled for 8 to 16 weeks at 4°C and then placed in a germinator set at 20°C for 16 hours (dark) and 30°C for 8 hours (light). Very little testing had been carried out for this species at the Seed Centre in the past. However, there was an indication that longer stratification periods may yield better results.

Ten seedlots were selected and moist chilled at 4°C for 8, 16, and 24 weeks and then placed in a germinator for 4 weeks. Results indicate that longer stratification yields better results (Table 16). None of the seedlots with 8 weeks moist chilling produced any germinants. The seedlots subjected to 16 weeks moist chilling performed better with germinations between 4 and 24 % (mean of 10.4%). Moist chilling for 24 weeks yielded the best results with germination percentages between 9 and 59 percent (mean of 26.7%).

It is interesting to note that most of the germination occurred prior to the seed being placed in the germinator. It is also interesting that the number of fresh seed, as determined by a cut test following the completion of the experiment, was high (average of 67.5%). Seed were considered as fresh when the endosperm was free of decay or other discoloration and should have been able to develop normally. A follow-up experiment should be developed to determine if longer stratification, warm/cold stratification, or germination of the seed in a cooler environment would produce better results.

Table 16. Germination (%) of striped maple (*Acer pensylvanicum*) seed moist chilled at 4°C for 8, 16, and 24 weeks.

	Stratification period (4°C)				
			24 weeks		
Seedlot #	8 weeks	16 weeks	HV[1]	D[2]	F[3]
9710029.0	0.1	23.0	22.0	5.0	73.0
9710034.0	0.1	4.0	9.0	1.0	90.0
9810040.0	0.1	6.0	19.0	3.0	78.0
9810041.0	0.1	5.0	23.0	1.0	76.0
9810049.0	0.1	7.0	17.0	16.0	67.0
9810052.0	0.1	7.0	13.0	10.0	77.0
9810055.0	0.1	20.0	34.0	8.0	58.0
9810067.0	0.1	12.0	39.0	1.0	60.0
9810081.0	0.1	6.0	32.0	1.0	67.0
9810204.0	0.1	24.0	59.0	12.0	29.0

HV[1] (High Vigor); D[2] (Dead or Empty); F[3] (Fresh)

Willow Storage Experiment

Three willow species: Bebb willow (*Salix bebbiana*), pussy willow (*Salix discolor*), and red-topped willow (*Salix eriocephala*) were collected in late May - early June, 1999. The seed was extracted within 3 days of collection, the samples were cleaned and the moisture contents determined. The fresh seed was tested at its original moisture content. Two replicates of 100 seeds each were germinated and the following results were obtained: *S. bebbiana* (89.0%); *S. discolor* (60.5%), and *S. eriocephala* (71.5%). The samples were then halved and one of the sub-samples dried to a lower moisture content. The seeds were placed in cryogenic vials and stored at four different temperatures (4°C, -20°C, -80°C, and -196°C). The seed will be tested at 3 months, 6 months, 12 months, 2 years, 3 years, 4 years, and 5 years. The results of the first 3 test periods can be found in Tables 17a, 17b, and 17c.

Although the seed have only been tested three times since they were stored, some interesting observations can be made. The first and probably most important observation is that willow seed can be successfully stored at extremely low temperatures (-80°C and -196°C) without any significant detrimental effects. Another interesting point is that moisture content does not appear to be critical in the storage of willow seed. In fact, the seed stored at the higher moisture contents appear to be doing better than those stored at lower moisture contents. The differences in germination percentages among the various storage conditions has not manifested itself yet. However, it is expected that the seed stored at 4°C will deteriorate over time.

Table 17a. Germination results (%) for *Salix bebbiana* stored at 4°C, -20°C, -80°C and -196°C and at moisture contents of 8.61% and 7.17%

Test Period	4°C		-20°C		-80°C		-196°C		Average
	8.61	7.17	8.61	7.17	8.61	7.17	8.61	7.17	
3 months	87.00	88.50	82.50	89.50	89.50	84.00	93.00	87.50	87.69
6 months	84.50	84.00	89.25	82.75	89.50	85.50	85.75	82.50	85.47
12 months	70.25	78.25	82.75	77.50	86.00	74.75	84.75	83.50	79.72

Table 17b. Germination results (%) for *Salix discolor* stored at 4°C, -20°C, -80°C, and -196°C and at moisture contents of 9.76% and 5.08%.

Test Period	4°C		-20°C		-80°C		-196°C		Average
	9.76	5.08	9.76	5.08	9.76	5.08	9.76	5.08	
3 months	54.50	72.50	59.50	72.00	75.50	56.00	68.50	63.50	62.25
6 months	55.50	56.00	69.50	48.00	69.00	57.75	68.00	63.00	60.84
12 months	34.00	0.00	57.00	51.50	53.00	53.25	62.50	52.50	46.72

Table 17c. Germination results (%) for *Salix eriocephala* stored at 4°C, -20°C, -80°C, and -196°C and at moisture contents of 8.51% and 7.31%.

Test Period	4°C		-20°C		-80°C		-196°C		Average
	8.51	7.31	8.51	7.31	8.51	7.31	8.51	7.31	
3 months	59.00	76.50	62.00	71.50	71.50	61.50	63.00	55.00	65.00
6 months	53.75	50.75	71.25	46.50	65.75	52.25	59.75	48.25	56.03
12 months	5.25	10.25	60.75	50.50	53.25	47.50	59.00	37.00	40.44

Directed Study

Daniel Knox, a fifth-year forestry student at the University of New Brunswick in Fredericton, completed a report for a directed studies course titled "An Indication of Germination Testing Frequencies for Viability for Eleven Orthodox Canadian Tree Species". The report provided curves for balsam fir, green alder, speckled alder, red maple, white spruce, black spruce, jack pine, lodgepole pine, red pine, pitch pine, and white pine.

The information for the report was derived from the NTSC database. Results suggested that all species should be tested immediately after collection. Testing frequencies varied by species and are as follows: Speckled alder, green alder, and red maple should be re-tested after 5 years storage; balsam fir, black spruce, white pine and white spruce should be tested after 10 years storage; pitch pine after 12 years, lodgepole pine and red pine after 18 years, and jack pine after 20 years. Germination curves indicating loss of germination over time were produced for all species.

EQUIPMENT CHANGES / MODIFICATIONS

Freezer Space

In order to accommodate the ever increasing need for storage space, extra shelving was purchased and added to both freezers. Some re-jarring of seed was necessary to eliminate taller jars in order to decrease the space between shelves. As seed are removed to fill seed requests or for testing, jars containing small quantities of seed are discarded in favor of smaller containers. This is an ongoing process.

Storage of Field Collections

In past years, cones and other collected seed were stored in a cone drying room. In 2001, the space in the cone drying room became filled very quickly. We were able to store our seed in an unused greenhouse. This storage area provided much better air circulation than did the cone drying room. The greenhouse benches are off the ground and allow air circulation from below. Consequently, the cones stored in the greenhouse tended to dry and open much faster than those in our cone drying room. In future years, we hope to be able to make use of this space for storing our seed prior to processing them in the lab. Another change was the use of burlap bags to collect and store large cones. These bags allow excellent air flow which promotes drying and opening of the cones.

Revision of the Seedlot Numbering System

The seedlot number is a number assigned to a seedlot by the NTSC. Historically, it was a 7-digit number consisting of the following: the first two digits indicating year of collection, the third digit representing a geographic region, and the final four digits a sequential number that made the seedlot number unique. As with many pre-Y2K systems, the two digits representing the year could not continue beyond 1999. Therefore, in 2000 the seedlot number became an 8-digit number with the year being represented by 4 digits, the geographic region now represented by the fifth digit, and the final 3 digits make the number unique. There is no plan to convert old numbers to the new system.

PROMOTION OF THE SEED CENTRE

Throughout the year, many opportunities arise to promote the National Tree Seed Centre to its clients and to the general public. Since the Seed Centre provides a service to the research community it is important to take advantage of these opportunities when they occur. These opportunities present themselves through many venues including tours of our facility at CFS-Atlantic and participation in organized forestry exhibits. The following cover the highlights of the Seed Centre's activities in 2000.

Visitors to the Seed Centre in 2000 included: the Forest Nursery Practices (course # 5912) class from the University of New Brunswick, the Canada Committee on Crops, a Chinese delegation consisting mainly of researchers and managers, Dr. Marek Krasowski, professor of forestry at the University of New Brunswick, a group of communication officers from various government organizations across New Brunswick, and Dr. Jane Seabrook, Jane Percy and colleagues from the Plant Propagation Centre, Agriculture Canada, Fredericton.

Seed Centre staff participated in the CFS Forest Road Show which was held in Truro, Charlottetown, and Fredericton in early May. Media were present at all three events and a picture of one of our displays was featured on the front page of The Daily Gleaner (Figure 20). Photos and an interview also took place in Truro but, to our knowledge, were not published. In February, the Daily Gleaner ran an article titled "Protecting the future of forests" (Figure 21).

Dale Simpson gave a presentation on February 17, 2000 at the Hugh John Flemming Forestry Centre as part of the Canadian Forest Service Seminar Series 2000. The presentation was entitled "The National Tree Seed Centre . . . in a Nutshell". He outlined the purpose and history of the Centre, summarized activities to date, and gave an overview of how seed is collected, processed, and stored.

They're called what?

— THE DAILY GLEANER/DIANE DOIRON PHOTO

WHAT ARE THOSE?: Christina Vietinghoff looks at red oak germinated seeds Thursday. Vietinghoff was at the Hugh John Flemming Forestry Complex as it held an open house to mark National Forest Week. **See story on C4.**

Figure 20. Picture of young girl looking at red oak germinants taken during Forestry Week that appeared on front page of The Daily Gleaner on May 12, 2000.

Protecting the future of forests

BY MIKE GANGE
for the Daily Gleaner

Dale Simpson knows he has a connection with the past but he also touches the future.

Simpson is manager of the National Forest Genetic Resources Centre, at the Atlantic Forestry Centre, where more than 10,000 seedlots of trees and shrubs, mostly from native Canadian species, are stored.

Although the centre had its beginnings in Petawawa, Ontario, at the National Forestry Institute, it was moved to Fredericton in 1996 and is now located in the federal wing of the Hugh John Flemming Forestry Centre. The national seed repository, occupying only a small office and a laboratory with a huge walk-in freezer, is an important part of forestry gene conservation.

"We get requests for seeds from all over the world, either for research on the seeds themselves or for research purposes on the germinated seeds," said Simpson.

Simpson provides seeds free of charge to researchers. Last year he had more than 60 requests and shipped out 500 seedlots to as far away as China and Estonia. The centre has seeds from more than 90 Canadian tree and shrub species as well as more than 100 exotic species.

"Most of those requests are for conifers, spruce, pine, fir, but we do get requests for some of our native hardwoods too," said Simpson.

— THE DAILY GLEANER/STEPHEN MACGILLIVRAY PHOTO

WE'VE GOT SEEDS: Dale Simpson, manager of the National Forest Genetic Resources Centre, looks at some Magnolia Acuminata seeds being stored in the freezer.

When the requests come in, the staff at the seed centre provide seed of known origin and quality to researchers. Not only is this valuable for the research but for gene conservation as well.

"I do feel I am part of history and part of the future too," said Simpson. "Our oldest seeds are probably a seedlot of Jack Pines that are 50 years old. We have others that were harvested last summer.

"With things like climate change, it is important for researchers to study how a tree planted today might not be as fit to grow in a changing climate.

"Other research might involve growing the seeds so that genetic modifications can be studied. Seeds cannot be genetically modified, but the germinated product might be, and then we could look at harvesting the seeds from that tree," said Simpson.

Seed is procured in several ways. Most of the seeds are collected by the centre staff while others are obtained through the co-operation of other Canadian Forest Service centres, provincial forest services, and forest industries. The seed is usually collected in fair to good seed years to ensure high quality and from a number of trees to have a representative genetic sample.

Getting out of the office and getting the seeds is the best part of the job for Simpson, who has both an undergraduate and a masters degree in Forestry from UNB.

"One time we were in Cape Breton, deep into the woods and we had to strain to hear anything. It was so quiet," he said.

"Sometimes the seeds are on the ground and we just pick them up. That might be the case with fruit, like the choke cherry. Sometimes we go out in a bucket truck but the fun part is to go climb trees, with spurs and a rope," said Simpson.

When the seeds are obtained, they are dried to four to eight per cent of their humidity, then kept in a humidity controlled freezer at constant temperatures. Stored in small glass jars, they may be kept for several years or several decades.

Simpson is aware of unique species that need to be protected and has worked to ensure those seeds are preserved.

"Bur oak is at risk in New Brunswick, as is butternut and we need to guard that gene conservation," he said.

Simpson would like help from the general public in guarding and conserving the forest's future. "We would like to know if someone has a stand of trees that are unique, like a stand of white pines 200 years old, so we can harvest seeds and preserve them," he said.

Simpson will be presenting an overview of the Seed Centre on Thursday, Feb. 17, at 10:30 a.m. in the K.C. Irving Theatre. His lecture is free of charge, and is called "The National Tree Seed Centre ... In a Nutshell."

Figure 21. Article that appeared in The Daily Gleaner on February 10, 2000.

PUBLICATIONS AND PAPERS

Dale was invited to present a paper at the Tree Seed Workshop held in conjunction with the 27th meeting of the Canadian Tree Improvement Association in Sault Ste Marie, Ontario. The theme of the workshop was "The Role of *Ex-situ* Germplasm Storage in Gene Conservation". Dale's paper was titled "The Role of the National Tree Seed Centre in Genetic Conservation". The paper covered factors affecting seed storage, presented some results from a number of species with seedlots stored in the Seed Centre for over 40 years, and re-affirmed that the Seed Centre is enthusiastic in participating and cooperating with the provinces and territories by storing germplasm and providing advice.

Two articles were published in the May and December issues of the Canadian Tree Improvement Association Tree Seed Working Group New Bulletin.

COLLABORATION WITH COLLEAGUES

Each year, opportunities arise for collaboration with CFS colleagues. In 2000, two projects are worthy of mention here.

Dr. Judy Loo and her group undertook a project to look at genetic diversity in mature hemlock stands. The purpose was to determine if the diversity present in the upper storey was being transferred to the regeneration. Several sites were chosen in New Brunswick, Nova Scotia, and Prince Edward Island. NTSC staff participated in most of the collections which stretched from mid-June to mid-July. In return for this time, Donnie McPhee and Kathleen Forbes spent a week in late-September in Nova Scotia collecting seed. Most of the species collected were in Cape Breton Highlands National Park, but an important red spruce collection was also made at Point Pleasant Park in Halifax.

Dr. Alex Mosseler needed help in collecting red spruce cones at PNFI. Bernard Daigle agreed to accompany Dr. Mosseler and help him with his collection. The red spruce are from a range-wide provenance test established in the late 1950s. The collections had to be made with minimal damage to the trees which meant that the trees had to be climbed and the cones picked from the trees. The weather cooperated and the work was completed within three days. While at Petawawa, we took the opportunity to collect Norway spruce from the Hudson's Place plantation.

SEED CERTIFICATION

The National Forest Genetic Resources Centre, of which the NTSC is part, also includes OECD seed certification. Canada as a member of OECD (Organization of Economic Cooperation and Development), was active in formulating the present Scheme. Canada began to apply the Scheme in 1970 in response to governments of several European countries insisting that seed could only be imported in compliance with the Scheme.

The government of Canada nominated the CFS as the Designated Authority to implement the Scheme. Practically all seed sold to Europe originated from British Columbia (BC) and Yukon. The CFS delegated responsibility for the operation of the Scheme to the Director General, Pacific Forestry Centre, Victoria, BC . Since then, responsibility has been extended to Director Generals of CFS centres located in other regions of Canada. Since 1996, management of the Scheme has been conducted from CFS-Atlantic in Fredericton.

The Scheme is applied uniformly by all 22 member countries. Certificates that accompany each seedlot are a guarantee of the provenance and that the rules were followed during collection, extraction, and cleaning.

In the late 1980's OECD members felt it was time to update the Scheme. This led to a complete revision that was completed in 1995. Genetically modified reproductive material (GMO) was included in the new Scheme. Although this is very progressive it has resulted in the Scheme not being accepted by all member countries. A number of meetings have been held with Dale Simpson, Manager National Forest Genetics Resources Centre, representing Canada. During the last meeting held in October, 2000, Dale was elected Vice-Chair of the Scheme. Future meetings will continue to focus on how to overcome the GMO issue.

NATIONAL TREE SEED CENTRE STAFF

Staff at the NTSC consisted of one full-time seed technologist (Bernard Daigle) and a fifth-year forestry student (Daniel Knox) who was hired for 13 weeks. The staff is under the supervision of the National Forest Genetics Resources Manager, Mr. Dale Simpson.

Several other individuals also contributed to the operations of the Seed Centre in 2000:

Ms. Lisa Bridges, a Career Edge intern, was provided to the Seed Centre for a period of two weeks (February 28 to March 10). Lisa's duties included germination testing and processing of seedlots.

Garry Scheer was made available to work at the Seed Centre. He worked from April 10 to June 19 and again from July 30 to December 31. He took over most of the germination testing during these periods. The high number of germination tests carried out in 2000 are in large part a result of Garry's work.

Chris McLaughlin was seconded to the Seed Centre. He worked from July 24 to September 18 and again from November 20 to December 31. His responsibilities included cleaning seed, preparing germination tests, 1000-seed weights, moisture contents, assisting with field collections, and processing of seedlots.

In October, Laurie Yeates (greenhouse) offered the services of Steve Gillis to assist with extra workload. Steve spent several days processing hemlock that had been collected in the field. In order to save time, hemlock is sometimes colleted by clipping branches and then removing the cones at a later time. Steve also participated in hemlock collections at Kouchibouguac National Park.

Finally, in September, Donnie McPhee and Kathleen Forbes assisted with seed collections of tree and shrub species in Cape Breton Highlands National Park. This week-long trip was in return for time spent by Seed Centre staff in June collecting hemlock samples from selected stands in New Brunswick, Nova Scotia, and Prince Edward Island.