National Tree Seed Centre

Annual Report

2001

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INTRODUCTION

This report is the fourth covering the activities of the National Tree Seed Centre (NTSC). Similar reports were prepared for 1998, 1999, and 2000. The purpose is to provide a summary of the activities of the NTSC for 2001. 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 Research Forest (PRF) 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; and 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).

Table 1. Seed stored at the NTSC as of December 31, 2001.

Seed Bank		Reserved		Tree Breeding		Gene Conservation	
# Species	# Seedlots	# Species	# Seedlots	# Species	# Seedlots	# Species	# Seedlots
203	4 127	42	1 994	33	3 358	8	1 356

Seed Bank seedlots are defined as 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, 2001 the NTSC Seed Bank had 120 different Canadian species (3 745 seedlots) in storage (Table 2). An additional 99 exotic species (382 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 is decreasing although some opportunistic acquisitions may still be made. The total number of seedlots increased by 469 in 2001.

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, 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 in the Seed Bank category.

Province	# Species	# Seedlots	%
Alberta	11	50	1.3
British Columbia	28	264	7.1
Manitoba	5	35	0.9
New Brunswick	63	621	16.6
Newfoundland	11	77	2.1
Nova Scotia	40	241	6.4
Ontario	59	1 512	40.4
Prince Edward Island	28	83	2.2
Québec	15	763	20.4
Saskatchewan	8	64	1.7
Yukon Territory	2	35	0.9
Total		3 745	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 by testing seedlots and informing researchers of the results is necessary but remains a low priority at this time.

The Tree Breeding category is made up of seedlots that originated from the genetics program at PRF and were transferred to the Seed Centre for storage. 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. As testing progresses the better quality Tree Breeding seedlots are moved to the Seed Bank category. The number of Tree Breeding seedlots decreased from 4 460 in 2000 to 3 358 in 2001. This reduction is a direct result of germination testing all of the white spruce seedlots that were in frozen storage. Seedlots that had acceptable germination were transferred to the Seed Bank. In 2001, all of the white spruce that was stored at -20°C was tested. The quality ranged from excellent to poor.

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. At present, these seedlots are 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 or -20°C) categories.

SEED COLLECTIONS IN 2001

The year 2001 was a poor seed year for most tree species in the Maritime provinces. Twenty-one different species were collected by NTSC staff (137 collections). The majority of the collections were made in New Brunswick (88) with 32 collections coming from Nova Scotia, 12 from Prince Edward Island, and 5 from Québec (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.

Several notable collections were made including hazel alder (*Alnus serrulata*) from the Saint Croix River in New Brunswick and from the Eel River near Meductic. This is the second collection of this species from the Saint Croix site and the first collection from the Eel River population. These collections represent the only known occurrences of this species in New Brunswick. Other species collected for the first time included scarlet hawthorn (*Crataegus coccinea*) and fly honeysuckle (*Lonicera canadensis*). These are not rare species but they had not been collected in the past.

Table 3. Seed Collections made by Seed Centre staff in 2001.

Species	N.B.	N.S.	P.E.I.	QC	Total
Acer rubrum	21	6	12	0	39
Acer saccharinum	2	0	0	0	2
Alnus crispa	6	1	0	0	7
Alnus serrulata	2	0	0	0	0
Crataegus chrysocarpa	1	3	0	0	4
Crataegus coccinea	1	0	0	0	1
Crataegus flabellata	4	0	0	0	4
Lonicera canadensis	1	0	0	0	1
Nemopanthus mucronatus	2	2	0	0	4
Picea glauca	0	6	0	0	6
Pinus banksiana	21	3	0	0	24
Pinus resinosa	0	11	0	0	11
Prunus pensylvanica	3	0	0	0	3
Prunus virginiana	2	0	0	0	2
Quercus rubra	1	0	0	0	1
Rhus typhina	2	0	0	5	7
Salix bebbiana	2	0	0	0	2
Salix discolor	1	0	0	0	1
Salix eriocephala	1	0	0	0	1
Sambucus canadensis	1	0	0	0	1
Tilia americana	1	0	0	0	1
Ulmus americana	13	0	0	0	13
Total	88	32	12	5	137

In addition to collections made by NTSC staff, seed was also acquired though donation and purchase (Tables 4 and 5).

Table 4. Species and number of seedlots acquired through donation by the Seed Centre in 2001.

Species	Origin	# Seedlots
Acer negundo	Manitoba	6
Larix decidua x kaempferi	Québec (Berthierville)	2
Larix laempferi	Québec (Berthierville)	5
Larix laricina	JD Irving Ltd.	3
Larix laricina	Fraser Paper (Atlantic Seed Centre)	1
Picea abies	Québec (Berthierville)	41
Picea glauca	Manitoba	10
Picea glauca	JD Irving Ltd.	3
Picea glauca	Kimberly-Clark (Atlantic Seed Centre)	1
Picea glauca	Fraser Paper (Atlantic Seed Cnetre)	4
Picea glauca	Bowater (Atlantic Seed Centre)	3
Picea mariana	Manitoba	7
Picea mariana	Kimberly-Clark (Atlantic Seed Centre)	2
Picea mariana	Stora (Atlantic Seed Centre)	4
Picea rubens	JD Irving Ltd.	5
Pinus banksiana	Manitoba	8
Pinus banksiana	JD Irving Ltd.	1
Pinus mugo	Québec (Berthierville)	6
Pinus resinosa	Manitoba	2
Pinus strobus	JD Irving Ltd.	4
Pinus sylvestris	Québec (Berthierville)	9
Pinus sylvestris	Ontario (Petawawa Research Forest)	9
Thuja occidentalis	JD Irving Ltd.	1
Total		137

The seedlots from the Ministère des Ressources naturelles du Québec (Provincial Seed Centre in Berthierville) were received in 2000 but did not appear in the 2000 report.

Table 5. Seedlots acquired through purchase by the Seed Centre in 2001.

Species	Origin	# Seedlots
Abies amabilis	Quality Seed Collections Ltd.	1
Abies balsamea var *phanerolepis*	Nova Tree Seed	1
Acer glabrum	Quality Seed Collections Ltd.	1
Alnus crispa var *sinuata*	Quality Seed Collections Ltd.	2
Betula papyrifera	Quality Seed Collections Ltd.	1
Cornus stolonifera	Quality Seed Collections Ltd.	1
Juniperus communis	Quality Seed Collections Ltd.	1
Juniperus scopulorum	Quality Seed Collections Ltd.	1
Larix occidentalis	Quality Seed Collections Ltd.	1
Picea engelmanii	Yellow Point Propagation	1
Picea engelmanii	Quality Seed Collections Ltd.	1
Picea sitchensis	Yellow Point Propagation	1
Pinus contorta var *latifolia*	Quality Seed Collections Ltd.	4
Pinus monticola	Quality Seed Collections Ltd.	1
Pinus ponderosa	Quality Seed Collections Ltd.	3
Pinus ponderosa	Yellow Point Propagation	1
Populus tremuloides	Quality Seed Collections Ltd.	2
Populus trichocarpa	Quality Seed Collections Ltd.	1
Prunus pensylvanica	Quality Seed Collections Ltd.	1
Prunus virginiana	Quality Seed Collections Ltd.	1
Pseudotsuga menziesii	Yellow Point Propagation.	1
Thuja plicata	Yellow Point Propagation	1
Tsuga canadensis	Nova Tree Seed	1
Tsuga heterophylla	Quality Seed Collections Ltd.	1
Tsuga mertensiana	Quality Seed Collections Ltd.	1
Total		32

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 90 per year) (Table 6). The number of seedlots supplied has ranged from 99 in 1996 to 1 603 in 1985 (average 795 per year). It is the policy of the Seed Centre to provide seed at no cost providing 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 6. 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	760
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
2001	33	26	59	1 309	46	1 355
Average	71	20	90	642	153	795

During 2001, a total of 59 seed requests representing 1 355 seedlots was processed. Many of the requests were from Canada but seed was also sent to Australia, China, Greece, Italy, North Korea, and the United States (Table 7).

Table 7. Number of requests and number of seedlots shipped by country in 2001.

Country	# Requests	# Seedlots
Australia	1	5
Canada	33	803
China	19	422
Greece	1	25
Italy	1	28
North Korea	1	58
United States	3	14
Total	59	1 355

There were several large seed orders in 2001. The most notable was a request from Dr. William H. Parker, Lakehead University, Thunder Bay, Ontario. A total of 576 white spruce seedlots were shipped to Dr. Parker. The seed is to be used in a climate change study.

Other notable requests included several large shipments of seed to China. Some problems were encountered at Customs in China and seed had to be destroyed. As a result of this, we are now requiring that all seed requests from China be accompanied by an import permit. The Canadian Food Inspection Agency insists that an Import Permit be filed before a Phytosanitary Certificate is issued. Import permits from China sometimes include stringent restrictions that we cannot meet and we have been unable to fill some requests.

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 each 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 when dealing with very small seed. Germination testing in 2001 concentrated on finishing the white spruce seedlots (Seed Bank and Tree Breeding) and seedlots acquired through donation. **One thousand eight hundred and ninety-one germination tests** were carried out in 2001. An additional 500 germination tests (approx.) were carried out as part of special projects and experiments. This was one of the most productive years!

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 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 approximately 1 to 2 grams each (for most species) are placed in aluminum containers and placed in a forced draft oven at 103°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 5 and 8 percent. Seed that are above this range are further dried before being stored. **Five hundred and fifty-one moisture content determinations** were carried out by NTSC staff in 2001.

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 **two hundred and ninety-two 1000-seed weights** were done in 2001.

Table 8. Number of germination (Germ.) tests, moisture content (MC) tests, and 1000-seed weight (TSW) tests, carried out between 1983 and 2001.

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
2001	1 891	551	292
Average	965	432	570

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

RESEARCH AND DEVELOPMENT

White Pine Seed Storage Experiment

Analysis of historical germination test data at the NTSC demonstrated that white pine seed viability steadily declines up to 20 years of age. Its rate of decline is more rapid than other native pine species. Storing seed cryogenically is often used routinely at agriculture seed centres and has been evaluated experimentally for various tree species. Although it is an expensive means for long-term storage of general seed collections, it can play an extremely important role for gene conservation of unique seed collections. An experiment was initiated in 2001 to evaluate storage of white pine seed of various moisture contents via traditional means at -20°C and cryogenically, in the vapor phase, at -145°C.

Cones were collected on September 8, 2000 from 3 trees in the UNB woodlot and on September 11 from 3 trees on a UNB property located in Noonan. Cones were spread on screen trays placed in an unheated but vented greenhouse until processed in November. Seeds were shaken from the cones, debris and dirt removed, seed de-winged by hand rubbing, and full seed separated from empty seed by floatation in 100% ethanol.

Moisture content of the seed from each tree was determined by weighing two replicates of two grams, placing the seed in a forced draft oven for 16 hours at 103°C, and weighing the dry samples. These moisture contents were designated as controls. Seed was then treated to achieve the three other moisture contents of 5, 8, and 11%. A sample from the control for each seedlot was placed in a forced draft oven set at 30°C and weighed periodically until its weight reflected the target moisture content of 5%. Likewise, samples were taken from each control and placed in fine mesh screen trays placed over water in germination boxes. Weights were periodically recorded until each sample achieved a target moisture content of 8 or 11%. As each sample reached its target moisture content it was quickly placed in a 10 ml cryogenic vial and sealed. The vials were placed in cryogenic boxes, each box representing a complete set of material for future testing. Each box contained 24 vials (6 trees x 4 moisture contents). All boxes were placed in a -20°C freezer overnight. The boxes destined for cryogenic storage were put in stainless steel towers and placed in vapor in a stainless steel storage tank.

A set of seed samples for each moisture content and tree were kept aside for moisture content determination and a germination test to provide baseline data. Approximately 1.2 to 1.5 grams of seed, depending on seed size and target moisture content, was removed from each vial for moisture content determination following the above procedure except that only one replicate was used. The remaining seed was used for the germination test. Seeds were placed on moistened Kimpak in Petawawa germination boxes using a vacuum plate. Four replicates of 50 seeds each were placed in each box. The boxes were transferred to a cooler maintained at 4°C for 28 days. After 28 days the boxes were placed in a Conviron G30 germinator. Germination conditions were 30°C with 8 hours light followed by 20°C with 16 hours darkness at a constant relative humidity of 85%. Germinants were first monitored at 7 days and at regular intervals thereafter for 28 days. Germinants were evaluated according to vigor class (Wang, 1973). Seed was considered germinated when vigor class 3 was reached as evidenced by cotyledons, upright hypocotyl, and developing radicle.

Moisture contents (MC), fresh weight basis, were conducted on a sample of each seedlot at the time of storage (Table 9). Generally, actual MCs were close to the target MCs with the exception of seedlots 131 and 135 which exceeded the target MC of 11% by a considerable amount.

Table 9 . Moisture content (MC) and germination (Germ.) of each seedlot at time of storage.

	Control MC		Target MC 5 %		Target MC 8 %		Target MC 11 %	
Seedlot	MC	Germ.	MC	Germ.	MC	Germ.	MC	Germ.
130	6.17	52.5	5.03	80.5	7.78	55.0	10.34	33.5
131	5.58	75.0	4.60	89.0	8.24	89.0	11.83	88.5
132	5.76	77.5	4.90	91.0	8.47	86.5	10.52	87.5
133	5.79	50.5	4.93	47.0	7.94	62.5	10.87	67.0
134	5.37	54.0	4.91	43.0	7.99	37.0	10.5.0	59.0
135	5.48	48.5	4.94	58.8	8.48	47.0	12.17	27.0

Germination within a target MC class varied between seedlots with an extreme range of 27 to 89% for target MC 11% (Table 9). Germination also varied within seedlots across the four MC classes. There was a difference between the two populations in germination. Total germination was higher for the UNB Woodlot population (seedlots 130, 131, and 132) as well as the speed of germination particularly between days 13 and 17 (Figure 1). A separation in germination between the moisture contents occurred by day 17 and was maintained to the completion of the test. By day 28 the average germination varied from 87% for the seedlots at 5% MC to 68% for the control seedlots. In contrast, seedlots (133, 134, and 135) from the Noonan population exhibited lower germination. The germination lines did not separate for each MC and the overall germination for the four MCs was within about 5% of each other (Figure 2). Tree-to-tree (seedlot) variation is also conspicuous for germination within each of the MCs and populations.

A set of seedlots will be removed from each storage condition after one year and moisture content determined and a germination test conducted.

Wang, B.S.P. 1973. Laboratory germination criteria for red pine (*Pinus resinosa* Ait.) seed. Proc. Assoc. Off. Seed Anal. 63: 94-101.

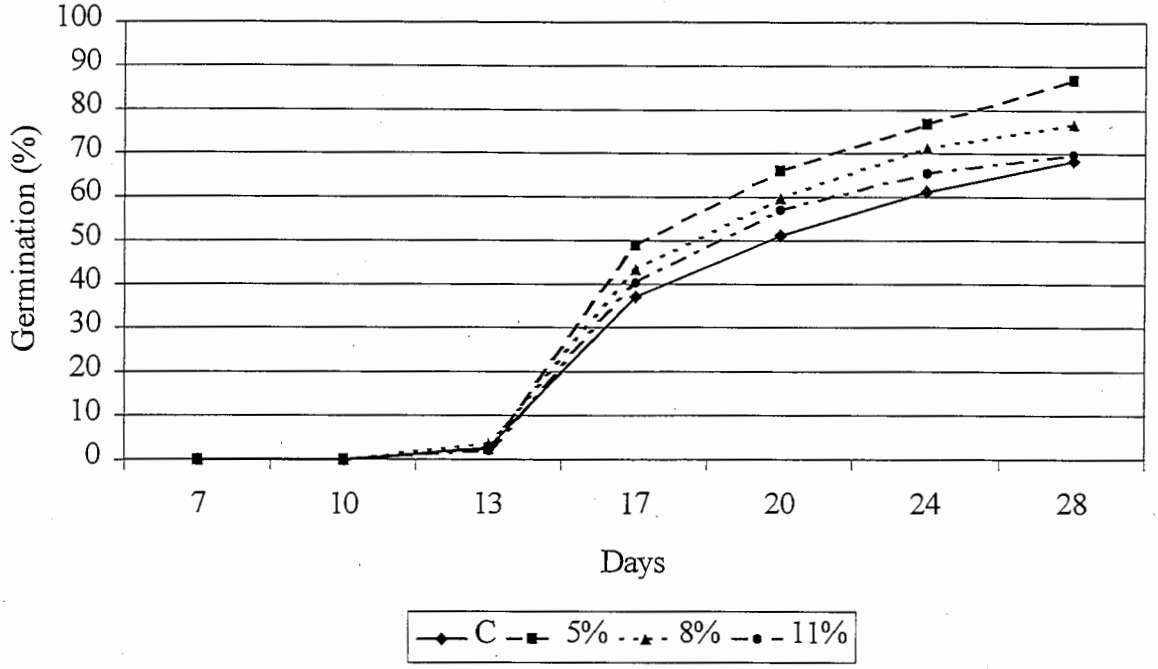


Figure 1. Germination of white pine seed, at time of storage, from UNB Woodlot conditioned to 4 moisture contents.

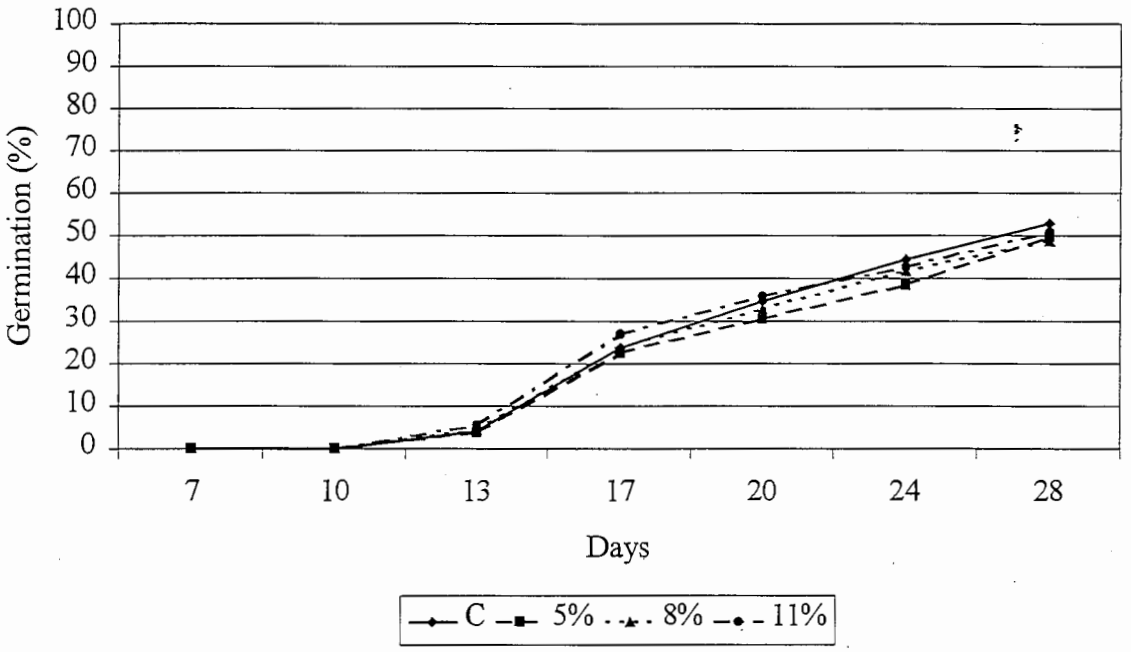


Figure 2. Germination of white pine seed, at time of storage, from Noonan conditioned to 4 moisture contents.

Red Oak Storage Experiment II

This experiment was set-up in 1999 and results after 12 months in storage were reported in (Daigle and Simpson, 2001). The purpose of this experiment was to evaluate the effect of freezing, to test another storage container, and to 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 Gortex™ or parafilm. The experiment was set-up to allow sampling every 6 months for 36 months. Results presented here are for 24 months (Figure 3). There was a marked steady decline in germination after 12 months storage but acorns stored at -2°C consistently maintained their viability. Acorns stored in 4 mil poly bags had the best germination after 24 months at both storage temperatures. Combining the data from each storage container for each storage temperature shows that storage at -2°C is superior (Figure 4).

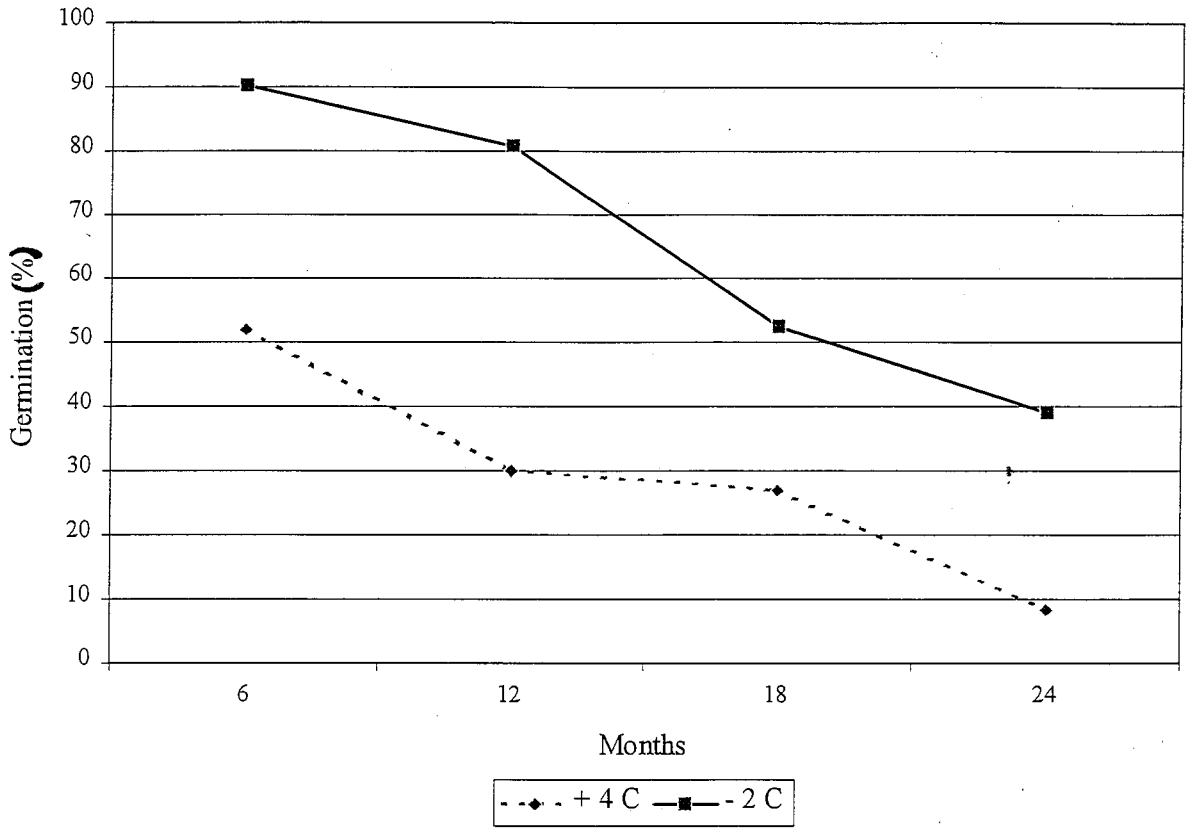


Figure 3. Germination of red oak acorns stored in several containers at 4°C and -2°C.

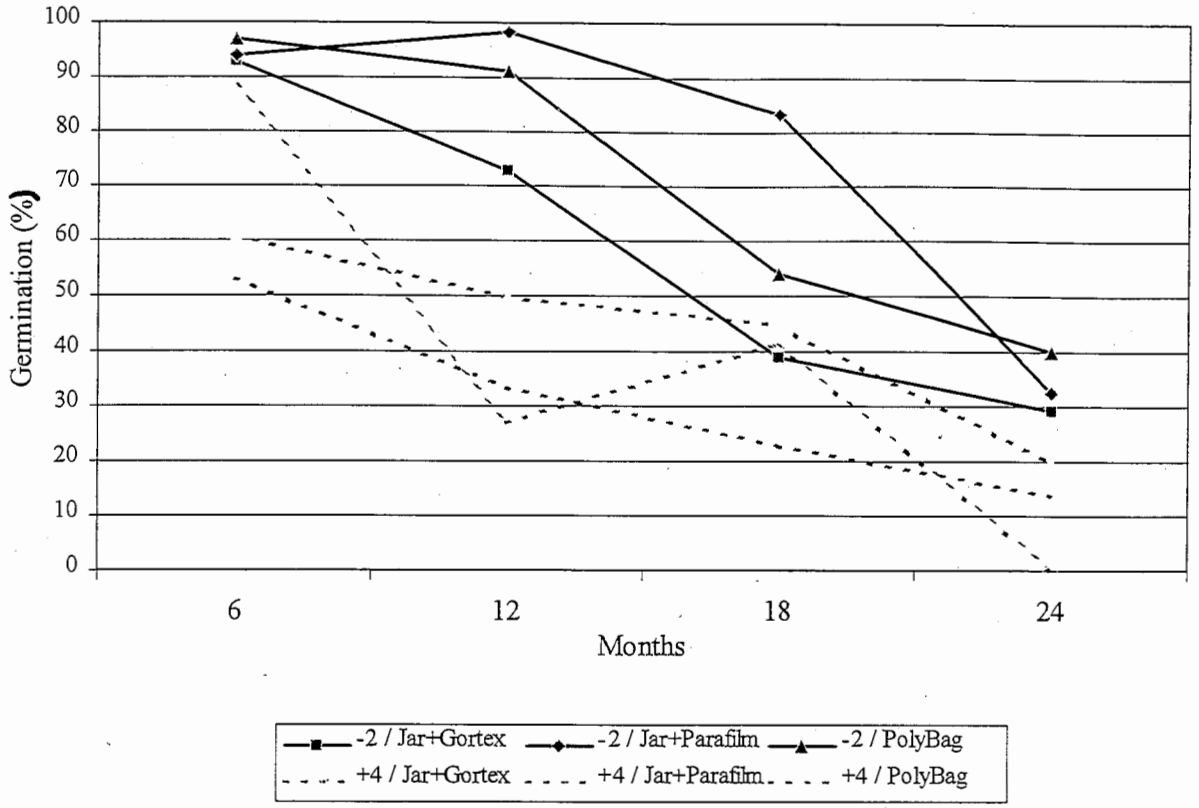


Figure 4. Change in germination of red oak acorns stored at two temperatures.

Moisture content (fresh weight basis) was also determined for a sample of acorns from each storage container. Interestingly, moisture content steadily increased with time (Figure 5). This may seem surprising but the logical reason is probably because the cooler and freezer, containing the acorns, is not dehumidified. Moisture in the air has been able to diffuse through the polyethylene, Gortex, and parafilm. The moisture uptake was less for acorns stored in jars with Gortex. The literature has indicated that a moisture content of 40% is critical for acorns to maintain viability. Once moisture content drops below this value acorns die. This premise is not supported in this study. In fact it indicates the opposite may be occurring. Acorns stored at 4°C in polybags and mason jars with parafilm covering the mouth had reached a moisture content of at least 43% after 24 months but their germination was much less than acorns stored at -2°C with moisture contents ranging from 38 to 40%.

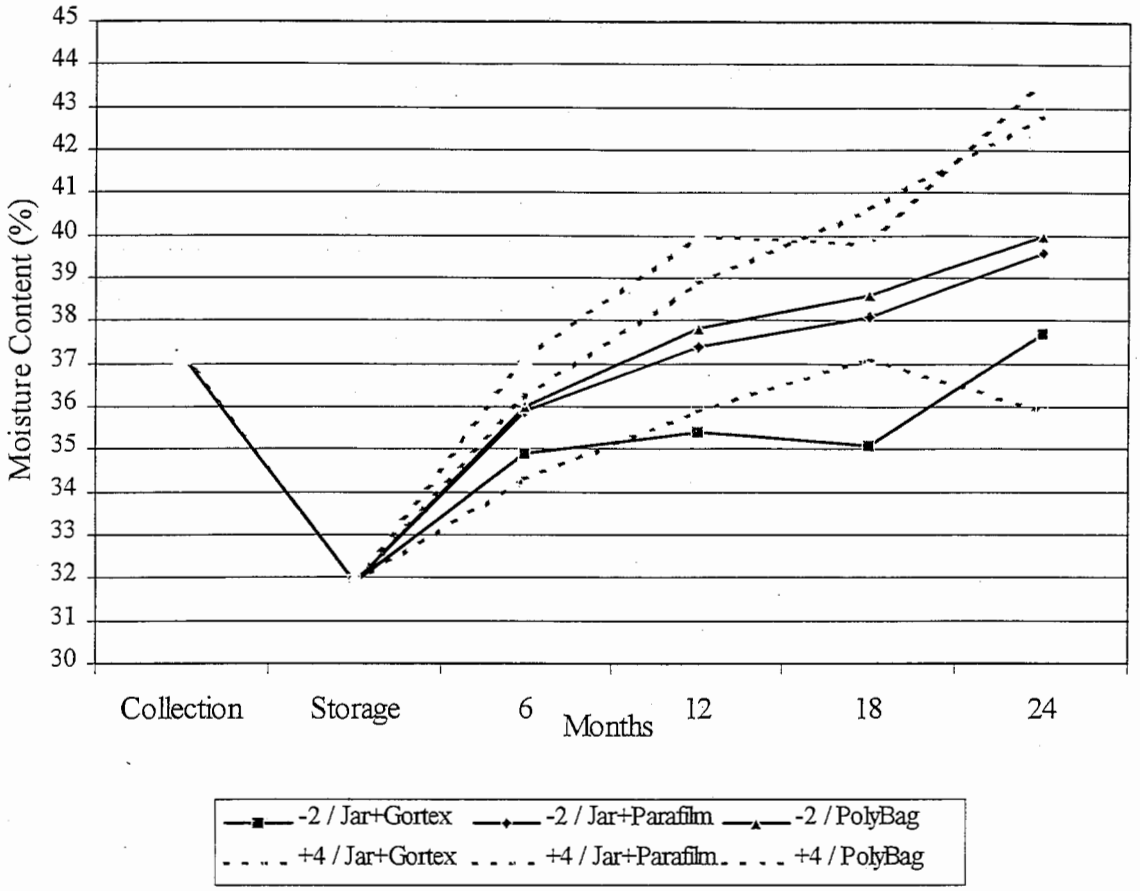


Figure 5. Change in moisture content of oak acorns stored at 4°C and -2°C in different containers.

Daigle, B.I., and Simpson, J.D., 2001. National Tree Seed Centre annual report 2000. Nat. Res. Can., Can. For. Serv. – Atl., 40 p.

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 1.0 ml cryogenic vials and stored at four different temperatures (4°C, -20°C, -80°C, and -196°C). The seed were tested at 3 months, 6 months, 12 months, and 24 months (Tables 10a, 10b, and 10c). Sufficient seed is available to allow for three more testing times.

Willow seed do not remain viable for long in nature. Unless the seed is able to germinate quickly, it will not survive. Seed collected and kept at room temperature (21°C) lose most of their viability after only a few weeks. It is therefore extremely important to process the seed as quickly as possible after collection. Even with such precautions, seed quality in some cases may be compromised. The mediocre germination results for the *S.discolor* and *S. eriocephala* may be due in part to deterioration of the seed prior to storage.

The results to date indicate that willow seed can be successfully stored for up to 2 years at extremely low temperatures (-80°C and -196°C) without any significant detrimental effects. Seed stored at -20°C also showed no substantial loss in viability. Seed stored at above freezing temperatures (4°C) has lost most of its viabilty after 2 years in storage. Moisture content does not appear to have a significant effect in the storage of willow seed. In fact, seed stored at the higher moisture contents appear to be doing better than those stored at lower moisture contents.

Table 10a. Germination of *Salix bebbiana* seed 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	
	8.61	7.17	8.61	7.17	8.61	7.17	8.61	7.17
3 months	87.0	88.5	82.5	89.5	89.5	84.0	93.0	87.5
6 months	84.5	84.0	89.3	82.8	89.5	85.5	85.8	82.5
12 months	70.3	78.3	82.8	77.5	86.0	74.8	84.8	83.5
24 months	2.0	2.0	81.5	79.5	84.5	72.3	80.3	79.5

Table 10b. Germination of *Salix discolor* seed 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	
	9.76	5.08	9.76	5.08	9.76	5.08	9.76	5.08
3 months	54.5	72.5	59.5	72.0	75.5	56.0	68.5	63.5
6 months	55.5	56.0	69.5	48.0	69.0	57.8	68.0	63.0
12 months	34.0	0.0	57.0	51.5	53.0	53.3	62.5	52.5
24 months	8.3	12.5	68.3	55.8	61.0	54.0	56.0	53.3

Table 10c. Germination of *Salix eriocephala* seed 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	
	8.51	7.31	8.51	7.31	8.51	7.31	8.51	7.31
3 months	59.0	76.5	62.0	71.5	71.5	61.5	63.0	55.0
6 months	53.8	50.8	71.3	46.5	65.8	52.3	59.8	48.3
12 months	5.3	10.3	60.8	50.5	53.3	47.5	59.0	37.0
24 months	0.0	1.5	56.0	43.8	56.0	38.3	62.0	52.0

The data suggest that seed store better at higher moisture content. However, this may not be the case. The seed were processed in late May – early June when the relative humidity in the lab was quite high. As a result, the moisture content could not be lowered by simply air drying the seed. The seed had to be placed in a forced air oven and dried at 30 – 35°C. This may have damaged or accelerated the ageing of the seed which resulted in poorer germination results for *S. discolor* and *S. eriocephala*.

Ironwood Germination Test

Ironwood (*Ostrya virginiana*) seed have a hard seedcoat and internal dormancy that is difficult to overcome. Germinating the seed is therefore difficult. The latest germination information suggests three months of warm stratification followed by 3 to 5 months of cold stratification as the preferred method. Ironwood is at the northern extent of its range in Canada. The methods used to overcome dormancy in the southern sections of its range may not work well here. Past experience with species such as red maple (*Acer rubrum*) and eastern hemlock (*Tsuga canadensis*) have shown that longer stratification yields better results for northern provenances.

Based on NTSC database records, very little testing had been carried out on ironwood seedlots in the past. Until 1996, seed were soaked for 24 – 48 hours and either moist chilled for 12 weeks or placed directly into the germinator. This procedure yielded no germination. In 1996, 2 seedlots were tested. The seed were warm stratified for 9 weeks followed by 20 weeks of moist chilling. This resulted in germination of 35 and 50%. Cut tests were not performed on the ungerminated seed and these two seedlots were not re-tested in 2001.

Fifteeen ironwood seedlots were tested in 2001. The seed were placed on moistened Kimpak and warm stratified at 20°C for 9 weeks. Following warm stratification, they were moist chilled at 4°C for an additional 20 weeks before being placed in a Conviron G30 germinator set at 20°C for 16 hours dark and 30°C for 8 hours light. The relative humidity was kept constant at 85%.

The results varied widely (Table 11) but all seedlots had "fresh" seed that did not germinate. There are many factors that may be affecting germination. Long, warm stratification often results in mold problems and this test was no exception. Mold did not appear to prevent the emergence of the radicle but may have inhibited its development. Seed was used from seedlots collected in 1984, 1992, 1998, and 2000. Some collections were made from individual trees and others were made up of seed from several trees. The earliest collection date is August 26, and the latest is October 12. Any future tests will need to narrow the range of variation between seedlots.

Although no definate conclusions can be made, it appears that seed collected too early does not germinate well. A more detailed experiment using fewer seedlots and more treatments is needed to try to increase the number of seed that germinate. Some suggestions would include: a treatment to control mold, varying the warm and cold stratification periods, varying the germination temperature, and soak vs. not soaking. This would make an excellent undergraduate thesis project.

Table 11. Germination results of ironwood seed.

Seedlot #	Coll. Date	Coll. Code	Germination Results (%)			
			High Vigor	Fresh	Empty	Dead
8430083	Sept 14	S	7.0	33.5		59.5
9230074	Aug 30	B	8.0	62.5		29.5
9230079	Aug 26	S	0.1	4.0		96.0
9230080	Aug 26	NA	0.1	24.0	20.0	56.0
9810208	Sept 16	B	21.0	69.5		9.5
9810209	Sept 17	B	24.0	30.5		45.5
9810210	Sept 2	B	2.5	86.0		11.5
9810211	Sept 18	B	14.5	55.0		30.5
9810212	Sept 1	B	11.5	71.0		17.5
9810213	Sept 25	B	45.5	32.5		22.0
9810129	Sept 11	S	6.0	90.0		4.0
20001056	Sept 1	B (5)	0.1	56.0		44.0
20001095	Oct 11	S	29.0	61.5		9.5
20001125	Oct 11	S	0.1	100.0		
20001127	Oct 12	S	24.0	70.0		6.0

White Elm De-winging

Thirteen white elm (*Ulmus americana*) single-tree seed collections were made on June 5, 6, and 7, 2001. The white elm seed has a fairly large fibrous wing which makes storage of large quantities difficult because of the space required to store the seed. Although it is not recommended to remove the wings of elm seed because of damage this would cause to the seed (Young and Young, 1992), de-winged seed stored at the National Tree Seed Centre at -20°C for 10 years was still viable and showed no ill effects from the de-winging process.

Following collection, seed were brought into the lab, placed on large screen trays, and allowed to dry until moisture content was sufficiently low to permit de-winging. Small samples were taken from each seedlot and the wings were removed by placing them in a cloth bag and rubbing. A series of rubbing, sieving, and blowing the seed in an air aspirator resulted in clean seed with no apparent damage. Germination tests were performed on the winged and totally de-winged samples (Table 12). The results indicate that de-winging did not negatively affect germination. In fact the de-winged seed performed better, probably due to the fact that insect damaged, empty, or otherwise inferior seed were removed during the de-winging process.

Although the above yielded excellent results, the work involved to completely remove the wing was excessive, especially if the moisture content was high (> 9 %). The high relative humidity inside the lab made it impossible to lower the moisture content of the seed. Even placing the seed in an oven set at 33°C had little effect on the moisture content of the seed and on days with high relative humidity the moisture content actually increased. It was possible to partially de-wing the seed with considerably less effort and this was tried and a germination test carried out on the partially de-winged seed. The germination test results of the partially de-winged seed were excellent, even surpassing the totally de-winged seed in some cases (Table 12). A possible reason for the slighly better results may be due to physical damage incurred during the de-winging operation for the totally de-winged seed. When attempting to de-wing elm seed it is important that the seed be very dry (less than 7 % MC). Seed that are not completely dry tend to matt when rubbing which increases the risk of damaging the seed.

Based on the findings, a light de-winging should be carried out on all elm seed once the seed has dried sufficiently.

Young J.A., and C.G. Young. 1992. Seeds of woody plants in North America. Disocorides Press. Portland, Oregon. 346-349.

Table 12. Germination results from winged, partially de-winged, and totally de-winged seed of white elm (*Ulmus americana*).

Seedlot #	Germination (%)		
	Winged Seed	Totally de-winged	Partially de-winged
20011005	86	98	100
20011006	93	94	97
20011007	93	100	100
20011008	88	99	99
20011009	88	94	95
20011010	94	97	100
20011011	90	96	97
20011012	84	100	100
20011013	87	100	98
20011014	94	99	98
20011015	92	99	100
20011016	85	100	100
20011017	82	85	93
Average	88.9	97.0	98.2

White Elm Storage Experiment

Five single-tree collections of white elm (*Ulmus americana*) were used in the experiment. The purpose of the experiment is to determine the effect of removing or partially removing the wing from the white elm achene. The five seedlots selected were collected on June 6, 2001 in Fredericton New Brunswick. All collections were made using a "bucket truck". The collections were made by staff of CFS-Atlantic and City of Fredericton.

A portion of the sample was left intact (not de-winged). The remaining seed was de-winged by rubbing the seed in a cloth bag, and then sieving and blowing in an air aspirator. This procedure had to be repeated several times until the wings were sufficiently removed. Based on preliminary tests it was decided not to completely remove all of the wing as this did not increase germination and may in fact lower it slightly. De-winging was facilitated when seed moisture content was below 8%. Seed that were too moist tended to form a matted ball and were difficult to process. Moisture contents were determined and seedlots with moisture contents above 8% were dried to below 8%. Germination tests were done on the winged and de-winged samples (Table 13). Five samples of winged and partially de-winged seed were placed in vials. The winged seed were stored in 29.6 ml hinged-cap plastic vials and the de-winged seed in 1.8 ml cryogenic vials. The vials were filled to capacity to simulate storage of filled containers and to mitigate the effect that air in the container might have on the storage of the seed. These vials were placed in Mason jars and stored at -20°C.

Table 13. Moisture content (MC), 1000-seed weight (TSW) and germination (Germ.) results of winged and de-winged seed of white elm (*Ulmus americana*).

Seedlot	Winged				De-winged			
	Quantity (gr)	MC (%)	TSW (gr)	Germ (%)	Quantity (gr)	MC (%)	TSW (gr)	Germ. (%)
20011008	1	7.9	5.24	88	0.72	7.3	4.09	99
20011010	1	7.1	5.35	94	0.72	7.7	3.83	100
20011012	1	8.0	5.69	84	1.35	7.5	3.81	98
20011013	1	7.6	5.40	87	1.20	7.5	3.50	98
20011014	1	7.2	4.73	94	0.66	7.1	3.44	100

De-winging of Old White Elm Seedlots

Based on the results obtained from the de-winging of the elm seed collected in 2001, a decision was made to de-wing the elm seedlots that had been previously stored at the Seed Centre. De-winging increased the germination of all seedlots (Figure 6).

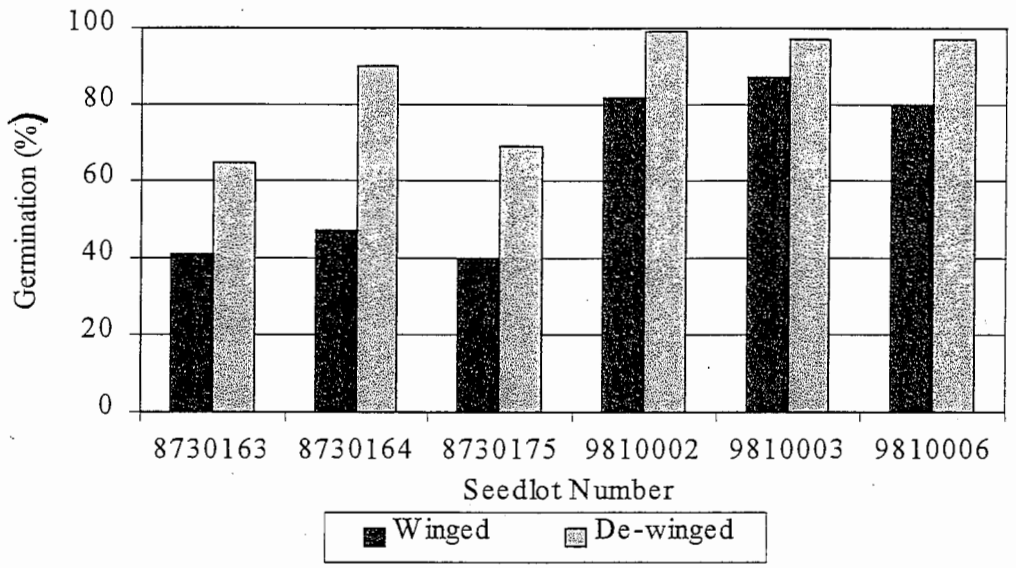


Figure 6. Comparison of germination of winged and de-winged seedlots of white elm.

De-winging of Old White Birch Seedlots

In 2000, all of the fresh collections of white birch (*Betula papyrifera*), grey birch (*Betula populifolia*), and mountain paper birch (*Betula cordifolia*) were de-winged prior to storage. This process, followed by blowing the seed in an air aspirator, resulted in higher germination and more efficient use of space (Daigle and Simpson, 2001).

A decision was made to de-wing the older white birch seedlots to determine if the quality of these seedlots could also be improved. A portion of each seedlot was de-winged and the remainder left untouched. This will allow for an evaluation of long-term storage of the de-winged vs. winged seedlots. The results were quite impressive with germination rates improving in all but one seedlot (Table 14). There was also an increase in the thousand seed weight in all of the de-winged seedlots.

Table 14. Germination test results of winged and de-winged white birch seedlots.

	Winged seed		De-winged seed	
Seedlot #	TSW	% Germ.	TSW	% Germ.
8570255	0.43	32	0.57	86
9130035	0.23	28	0.53	80
9130036	0.43	61	0.55	97
9130039	0.35	50	0.36	61
9130041	0.28	29	0.32	44
9130042	0.51	65	0.52	78
9130043	0.34	4	0.42	21
9810054	0.48	36	0.49	61
9810059	0.39	33	0.41	45
9810091	0.35	42	0.44	72
9810092	0.39	53	0.45	49
9810102	0.48	49	0.5	53
9810110	0.27	12	0.38	42
9810113	0.43	31	0.54	85
9810134	0.34	40	0.43	53
9810135	0.33	39	0.33	49
9810140	0.36	44	0.39	54
9810143	0.28	19	0.42	48
Average	0.37	37	0.48	60

Daigle, B.I., and Simpson, J.D., 2001. National Tree Seed Centre annual report 2000. Nat. Res. Can., Can. For. Serv. – Atl., 40 p.

Alcohol Separation of White Birch Seedlots.

Four white birch (*Betula papyrifera*) seedlots with poor germination (6.5 – 14.0 %) were selected for this test. The seeds were de-winged, sieved, and lightly blown in the air aspirator to remove the lighter seed and wings. Alcohol separation (using 100% ethanol) was used to separate filled and empty seed. After 10-15 seconds in the alcohol, the seeds were rinsed with tap water and laid on coffee filters to dry. Two replicates of 100 seed each from the original winged sample and the sample passed through the alcohol were placed on moistened Kimpak and placed in a Conviron G30 germinator set at standard conditions for 3 weeks. Results from this test can be seen in Figure 7.

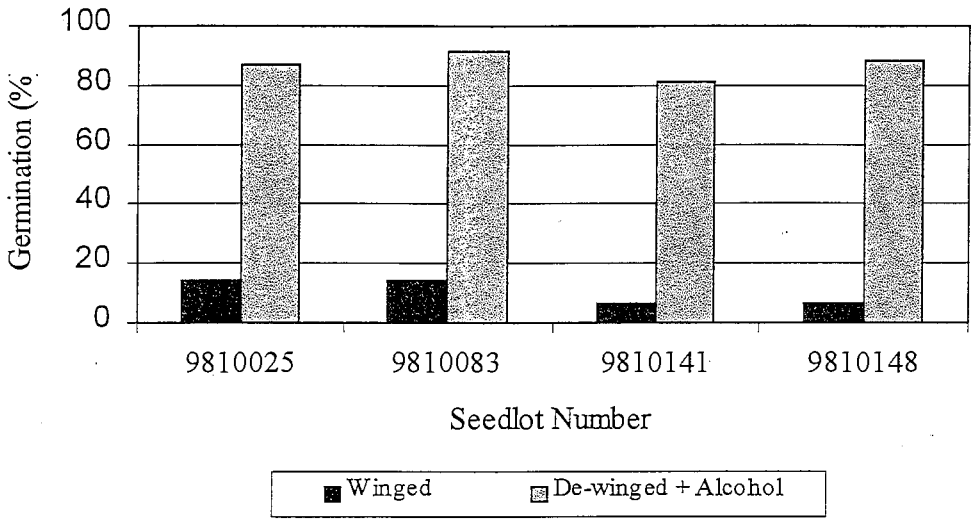


Figure 7. Comparison of germination results between winged and de-winged plus alcohol separated white birch (*Betula papyrifera*) seed.

Germination of the seed that were separated using alcohol was much greater than for the winged seed. These results are phenomenal but it is not known whether the alcohol will have a detrimental effect on the seed.

Therefore, a test was carried out to determine the effect of alcohol separation on germination and vigor of white birch. A single white birch seedlot (9130042.3) was selected for this test. The seedlot had been previously de-winged and germination was determined to be at 78%. Eight samples of one gram each were subjected to immersion in pure ethanol for periods of 15, 30, 45, 60, 120, 180, 240, and 300 seconds. The seed were then rinsed in tap water for 15 seconds and laid out to dry. Once dried, four replicates of 50 seed each were placed on moistened Kimpak and placed in a germination cabinet for 21 days.

Although total high vigor germination was not affected by the length of time of immersion in alcohol, the time it took the seed to germinate was affected (Figure 8). The biggest difference occurs between one minute and two minutes in which the percentage of high vigor germinants after 14 days in the germinator decreases from about 25% to about 5%. A similar trend also occurs at 18 days (reduction from about 80% to about 65%). At day 21, the effect of the alcohol was no longer apparent.

It appears that alcohol has a negative effect on germination when the exposure is greater than one minute in duration. In practice, seed is only in contact with the alcohol for 10 – 15 seconds after which the seed is rinsed with water. This process further improved the germination of the seedlot from 78 to 90% .

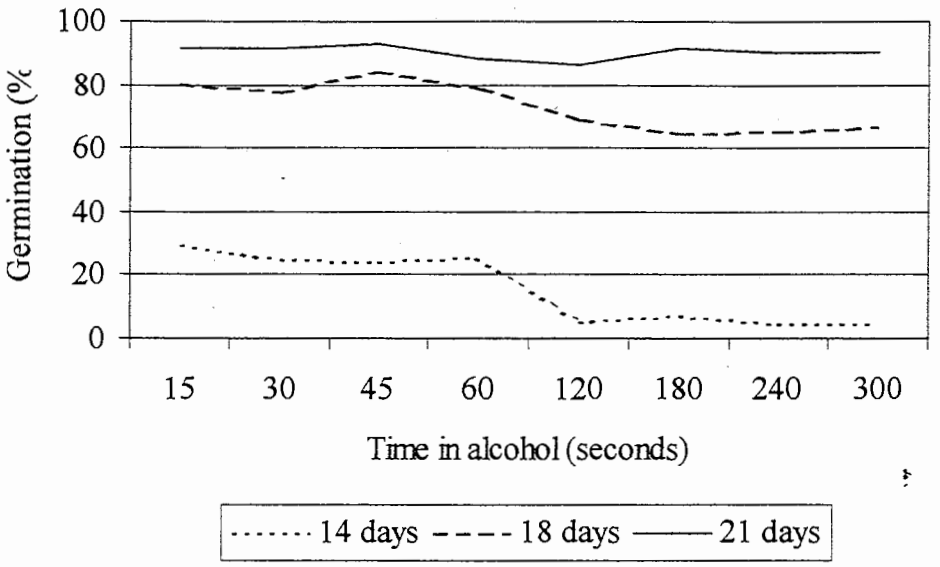


Figure 8. Effect of duration in alcohol on germination of white birch seed after 14, 18, and 21 days.

Seed Priming Test (Atlantic Forest Seed Centre)

Kathy Tosh from Tree Improvement at the Kingsclear nursery contacted us about participating in a seed priming trial. Kathy had received this procedure from a grower in Québec (La maison verte). This technique is used by the grower to accelerate germination. Each litre of distilled water contained: 0.1 gm Potassium Nitrate, 0.02 gm Sodium Phosphate (NaH_2PO_4), 0.01 gm Calcium Nitrate, 0.001 gm Boric Acid, and 33.3 ml of 3% Hydrogen Peroxide. A 2:1 ratio of solution to seed was used.

The test consisted of soaking Norway spruce, white spruce, and eastern white pine seed in the solution. Two samples were used for each species. One sample was soaked in solution only and the other was soaked in solution while being aerated. The solution plus seed was stirred periodically. The solution was "recharged" by adding 33.3 ml of hydrogen peroxide at 20, 28 and 44 hours. Seed was soaked for a total of 48 hours. Following soaking, seed was startified for 28 days. Table 15 presents the results in addition to the results from non-treated seed (control).

Table 15. Results of seed germinated using seed priming technique.

Germ. Time	White spruce			Norway spruce			Eastern white pine		
	Control	Non-aerated	Aerated	Control	Non-aerated	Aerated	Control	Non-aerated	Aerated
7 days	30.5	36.5	57.0	68.8	29.5	68.3	28.3	6.5	41.3
14 days	71.8	84.3	88.0	88.8	67.8	82.5	81.3	9.0	57.3
21 days	84.5	88.3	88.8	91.5	70.0	83.0	88.5	12.0	68.3
28 days	87.5	89.5	89.5	---	70.5	83.3	88.5	12.5	72.0

Mold appeared on the aerated and non-aerated seed during weeks three and four for the Norway spruce and was present throughout the duration of the test for the eastern white pine. The control test for the Norway spruce was seed collected from the same provenance but in a different year. This limits the conclusions that may be drawn from this part of the data. Germination up to day 14 of the aerated treated white spruce seed was improved. The results for the Norway spruce and the white pine are not as clear although it appears that the aerated seed performed much better. A follow-up test using more seedlots and tighter controls is recommended.

ISTA REFEREE TEST

An email was received from Elena Foffová, Forest Research Institute Zvolen, Slovak Republic inviting the Seed Centre to participate in an ISTA referee test. The Institute's tree seed laboratory had recently received ISTA re-accreditation and the auditors had recommended them to organize a referee test. Seed Centres in 16 other countries participated. The NTSC and the National Tree Seed Laboratory in the USA were the only two from the Americas invited to participate.

Five samples were received in late July. One sample each of *Larix decidua* and *Picea abies* was required to be evaluated for purity, one thousand seed weight, and germination. Germination was only required for the 3 other samples (1 *Picea abies* and 2 *Pinus sylvestris*).

The test provided NTSC staff the opportunity to apply the ISTA Seed Testing Rules. This revealed some ambiguities and confusion especially with regard to winged vs. pure seed for *Larix* for the purity evaluation portion of the test. Definitions and use of the terms 'integument', 'testa', and 'wing' are not clear. In any event, this portion of the rules was interpreted to the best of our ability and applied consistently.

The *Larix decidua* Sample # 1 was very dirty; containing just less than 50% pure seed. Of this, 75 % of the seed still had some or all of the wing attached. Germination was very low (33 %) with just over 50 % of the seed tested being dead. In contrast, the *Picea abies* Sample # 2 was much cleaner; just over 99 % pure seed. Germination was quite good at just over 80 % with an additional 8 % of the seed being fresh which did not germinate. Sample # 3, *Picea abies*, had very good germination at just over 95 % while the germination of Sample #s 4 and 5, *Pinus sylvestris*, varied from 87 to 70%, respectively.

It is hoped that the NTSC will receive a final report summarizing the results of the test to evaluate how our results compare with other seed centres.

Sample No. 1

***Larix decidua* Mill.**
35 g submitted sample for purity analysis, weight determination and germination test.

Purity test:

Method:
Carry out the test according to ISTA Rules 1999 (definition of pure seed 51 with winged seeds) on one working sample or two sub-samples (minimum weight indicated in the column 4 of table 2A: for one working sample – 17 g):

		One whole working sample		Two sub- samples			
				First		Second	
		g	%	g	%	g	%
Weight of the sample:			-		-		-
Pure seeds							
	winged:	6.00	33.52				
	without wing:	2.76	15.42				
	total:	8.76	48.94				
Other seeds:							
Innert matter:		9.14	51.06				
Sum of weights of component parts:		17.90	*100.0		*		*

* - the percentage of the initial weight of the sample

Weight determination:

1. Counting replicates
Weight of replicates in g:

1	0.38	5.	0.40	9.		13.	
2	0.41	6.	0.41	10.		14.	
3	0.39	7.	0.39	11.		15.	
4	0.39	8.	0.40	12.		16.	

Coefficient of variation for eight replicates: 2.65

Weight of 1000 seeds counted from 8 replicates: 3.96

Germination test:

Method:

Substrate: Top of paper (Kimpak)
Temperature: Alternating 16 hours 20°C/ 8 hours 30°C (+ light)
Duration: 21 days (longer if necessary, but maximum 32 days)
Replicates: 4 – counted on 4 x 100 seeds on 7th, 14th and 21st day

Date of beginnings:		Replicates				Results (average %)
		A	B	C	D	
Normal germinants	at day 7th	12	16	21	23	18.00
	14th	9	14	21	16	15.00
	21st	0	1	0	0	0.25
	?					
	total	21	31	42	39	33.25
Abnormal germinants*		1	1	1	2	1.25
Hard seeds (not expected)						
Fresh seeds		6	10	4	4	6.00
Dead seeds		61	48	48	47	51.00
Other (empty) seeds		11	10	5	8	8.50

? - If counted later, record the day of the counting
* - If abnormal germinants, record details of abnormalities

Sample No. 2

Picea abies (L.) H Karsten
40 g submitted sample for purity analysis, weight determination and germination test.

Purity test:

Method:
Carry out the test according to ISTA Rules 1999 (definition of pure seed 47 with winged seeds) on one working sample or two sub-samples (minimum weight indicated in the column 4 of table 2A: for one working sample – 20 g):

		One whole working sample		Two sub- samples			
				First		Second	
		g	%	g	%	g	%
Weight of the sample:			-		-		-
Pure seeds							
	winged:	2.32	11.57				
	without wing:	17.60	87.78				
	total:	19.92	99.35				
Other seeds:							
Innert matter:		0.13	0.65				
Sum of weights of component parts:		20.05	*100.0		*		*

* - the percentage of the initial weight of the sample

Weight determination:

1. Counting replicates
Weight of replicates in g:

1.	0.84	5.	0.81	9.		13.	
2.	0.83	6.	0.81	10.		14.	
3.	0.86	7.	0.81	11.		15.	
4.	0.80	8.	0.83	12.		16.	

Coefficient of variation for eight replicates: 2.43

Weight of 1000 seeds counted from 8 replicates: 8.24

Germination test:

Method:
Substrate: Top of paper (Kimpak)
Temperature: Alternating 16 hours 20°C/ 8 hours 30°C (+ light)
Duration: 21 days (longer if necessary, but maximum 32 days)
Replicates: 4 – counted on 4 x 100 seeds on 7th, 14th and 21st day

Date of beginnings:		Replicates				Results (average %)
		A	B	C	D	
Normal germinants	at day 7th	23	23	20	13	19.75
	14th	50	55	59	76	60.00
	21st	2	0	2	0	1.00
	?					
	total	75	78	81	89	80.75
Abnormal germinants*		1	1	3	0	1.25
Hard seeds (not expected)						
Fresh seeds		11	10	7	5	8.25
Dead seeds		7	5	4	0	4.00
Other (empty) seeds		6	6	5	6	5.75

? - If counted later, record the day of the counting
* - If abnormal germinants, record details of abnormalities

Sample No. 3

***Picea abies* (L.) H Karsten**
Sample of at least 600 seeds for germination test.

Germination test:

Method: The same as described in sample No.1 (or No. 2) for germination test.

Date of beginnings:		Replicates				Results (average %)
		A	B	C	D	
Normal germinants	at day 7th	25	24	25	21	23.75
	14th	69	71	70	76	71.50
	21st	0	0	0	1	0.25
	?					
	total	94	95	95	98	95.50
Abnormal germinants*		0	1	2	2	1.25
Hard seeds (not expected)						
Fresh seeds		3	1	3	0	1.75
Dead seeds		2	0	0	0	0.50
Other (empty) seeds		1	3	0	0	1.00

? - If counted later, record the day of the counting
* - If abnormal germinants, record details of abnormalities

Sample No. 4

***Pinus sylvestris* L.**
Sample of at least 600 seeds for germination test.

Germination test:

Method: The same as described in sample No.1 (or No. 2) for germination test.

Date of beginnings:		Replicates				Results (average %)
		A	B	C	D	
Normal germinants	at day 7th	63	62	74	72	67.75
	14th	23	22	13	17	18.75
	21st	0	1	1	0	0.50
	?					
	total	86	85	88	89	87.00
Abnormal germinants*		2	5	1	4	3.00
Hard seeds (not expected)						
Fresh seeds		12	10	11	7	10.00
Dead seeds		0	0	0	0	
Other (empty) seeds		0	0	0	0	

? - If counted later, record the day of the counting
* - If abnormal germinants, record details of abnormalities

Sample No. 5

***Pinus sylvestris* L.**
Sample of at least 600 seeds for germination test.

Germination test:
Method: The same as described in sample No.1 (or No. 2) for germination test.

Date of beginnings:		Replicates				Results (average %)
		A	B	C	D	
Normal germinants	at day 7th	61	55	58	55	57.25
	14th	12	11	11	11	11.25
	21st	0	2	3	3	2.00
	?					
	total	73	68	72	69	70.50
Abnormal germinants*		0	7	3	2	3.00
Hard seeds (not expected)						
Fresh seeds		27	24	24	29	26.00
Dead seeds		0	1	1	0	0.50
Other (empty) seeds		0	0	0	0	

? - If counted later, record the day of the counting
* - If abnormal germinants, record details of abnormalities

REVISION OF THE SEEDLOT NUMBERING SYSTEM

The de-winging of birch, alder, and elm seedlots as well as the tranferral of Tree Breeding seedlots to the Seed Bank's inventory has forced us to revise our seedlot numbering and, in particular, the suffixes attached to the seedlot numbers. This is necessary in order to distinguish between seedlots that for any number of reasons may have been stored or have received a different treatment. Examples include the large number of white spruce seedlots from the range-wide collections. These seedlots were stored in the Seed Bank, Tree Breeding, in small packages (TB_fre) and in vials (4°C). In some cases the same seedlot is represented in all four places. Other examples are the de-winged birch, alder, and elm seedlots. In some cases, the seed has been stored for many years. Once de-winged, or otherwise altered, the seedlot must be assigned a new suffix to ensure that the test data information is not confused.

Following is a list of suffixes that has been implemented to facilitate the numbering of these seedlots:

suffix ".1"	Added to a Tree Breeding seedlot (-20°C) that is transferred to the Seed Bank.
suffix ".2"	Added to a Tree Breeding seedlot (4°C) that is transferred to the Seed Bank.
suffix ".3"	Added to any old seedlot that has been de-winged or to new seedlots where both winged and de-winged seed are stored.
suffix ".4"	Added to any old seedlot that has been de-winged and alcohol separated or to new seedlots where winged, de-winged, and/or de-winged + alcohol-separated seed are stored.
suffix ".5"	Added to the seedlots formerly in the TB_fre category that were stored at -20°C. These seedlots are mostly white spruce from the range-wide collection and were stored in 5 – 10 gram plastic packets in large Mason jars and
	Identifies a seedlots that is designated for gene conservation.
suffix ".8"	Added to white spruce seedlots from range-wide collections that were stored in 2.5 gram vials at 4°C.
suffix ".9"	Used to identify a seedlot that has been altered (explanation required).

SEED CERTIFICATION

Administration of the OECD (Organization for Economic Cooperation and Development) seed certification program falls under the National Forest Genetic Resources Centre, of which the NTSC is a part. The scheme titled "OECD Scheme for the Control of Forest Reproductive Material Moving in International Trade" has been applied in Canada since 1970. The CFS was nominated by the Government of Canada as the Designated Authority to implement the Scheme. Although the Director General at each forestry centre has the responsibility to operate the Scheme, practically all seed certification has been conducted by the Pacific Forestry Centre in response to demand, primarily by European seed dealers, for seed from west coast tree species.

Demand for certified seed was quite high in the 1970's and 1980's but has declined (Figure 9). Several reasons for the decline are increasing collections in Europe from proven plantations of Canadian west coast species and derogation procedures implemented by the EU. Derogation has meant that European seed dealers must apply for permission to import seed only after they have determined sufficient quantities will not be available on the European market. This often means they do not know what their domestic market supply is well enough in advance for them to place orders with BC seed dealers. This has made it increasingly risky for BC seed dealers to make collections in speculation that there will be a market for the seed.

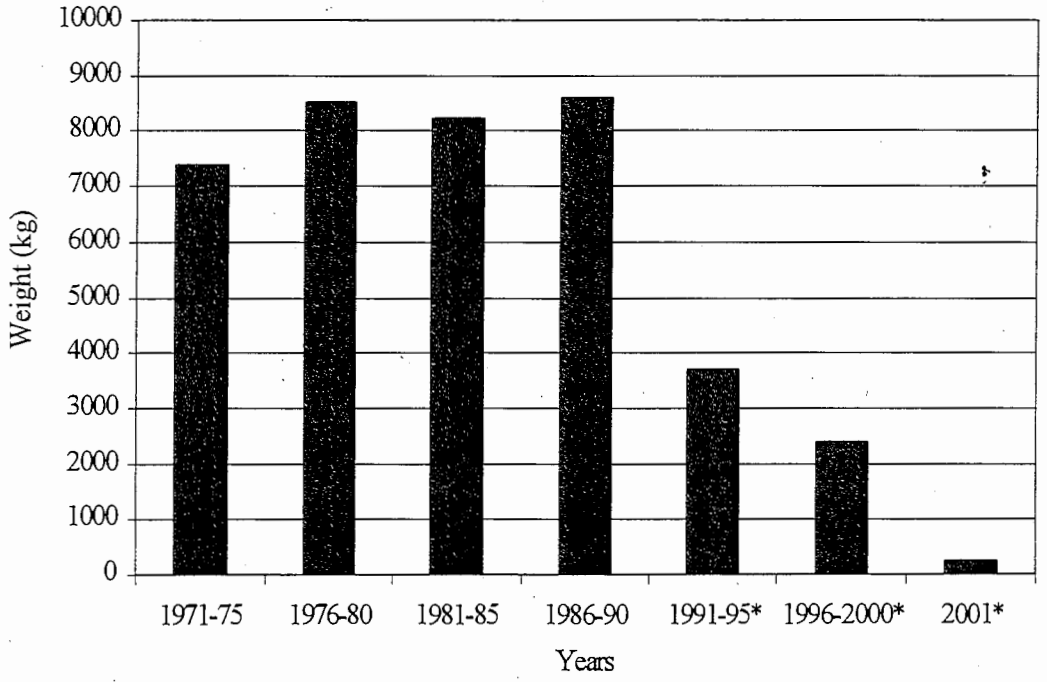


Figure 9. Weight of seed OECD certified or exported (*) by 5-year periods.

The new Scheme, completed in 1995, still awaits approval among the member countries. The principal obstacle is the inclusion of GMO (genetically modified organisms) which the United States has strenuously objected to. On the other hand, several European countries have introduced new forestry legislation which incorporated the new Scheme. As well, the EU developed a Directive, closely paralleling the OECD Scheme, for implementation by its member countries. Since this Directive only applies to trade among EU countries the OECD Scheme is then necessary for trade between countries when at least one is not an EU member.

PROMOTION OF THE SEED CENTRE

Many opportunities arise throughout the year to promote the NTSC to clients and the 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 the facility and participating in conferences or other meetings. The following highlights the activities in 2001.

Visitors to the NTSC in 2001 included: the Forest Nursery Practices (FOR 5912) and Plant Propagation (BIOL 2422) classes from the University of New Brunswick, students from the Maritime Forest Ranger School, delegates to the Canadian Seed Growers Association annual meeting, the National Executive of the Canadian Institute of Forestry, a Chinese delegation from Jilin Province, Om Rajora of the StoraEnso Senior Chair in Forest Genetics and Biotechnology at Dalhousie University, and our Deputy Minister Dr. Peter Harrison.

Mr. Ben Wang, Research Scientist Emeritus visited the Seed Centre during the week of February 3-7. Mr. Wang was instrumental in the creation of the NTSC and is well known nationally and internationally for his research work with seed. This was Ben's first visit to the Seed Centre since it moved from Petawawa in 1996. The purpose of the visit was to evaluate the operation of the Seed Centre and to share his expertise.

Several articles appeared in newspapers and forestry trade journals. Favorable press coverage occurred in The Chronicle-Herald February 6, 2001 (Figure 10) and The Sunday Herald February 11, 2001 (Figure 11) in response to staff making red spruce cone collections in Point Pleasant Park, Halifax. Staff took the opportunity to make collections due to the good seed crop in light of the harvesting that occurred in the Park to remove mortality attributed to the Brown Spruce Long-Horn Beetle. This seed is available for Park reforestation projects.

An article of a more general nature was printed in Nos Forêts (Figure 12). The purpose and role of the Seed Centre is outlined as well as how seed is stored.

Contributo

The Canadian Forest Service has collected more than 50 litres of red spruce cones in Halifax's Point Pleasant Park to try to replace the trees destroyed while officials tried to rid the park of the brown spruce longhorn beetle.

Enough seeds saved to do the job

Point Pleasant could be replanted 100 times, according to officials

By Susan LeBlanc
Staff Reporter

Have no fear. Enough red spruce seed has been harvested from Point Pleasant Park to replant it 100 times.

"I'm hoping we'll get at least 200,000 seeds," said Dale Simpson of the Canadian Forest Service, which collected the seed last September.

After the Canadian Food Inspection Agency announced last spring its intention to chop thousands of park evergreens because of a foreign beetle infestation, Mr. Simpson ordered seed collection there.

In September, his staff gathered 50 litres of red spruce cones. It was the first good seed year for red spruce since 1996.

The seeds remain in the cones in Fredericton, where Mr. Simpson runs Canada's only national seed bank.

After the seeds are shaken out and cleaned, they'll be stored in Mason jars in walk-in freezers kept at –20 C. Red spruce seeds can last 50 years at that temperature, Mr. Simpson said.

The Point Pleasant seeds join a collection of over 10,000 seed lots from 100 Canadian species. Seeds are usually doled out for research purposes.

But Mr. Simpson said he'd allow their use for a project such as replanting Point Pleasant Park, where the last of 2,200 evergreens are being removed this month.

"I really prefer, when the opportunity is there, when you want to replant a site, you should always try and plant a seed that's come off that site or grew under the same conditions or is from an adjacent site," he said.

As restoration planning begins for Point Pleasant, it's difficult to say if that storehouse will ever be drawn upon.

The Nova Scotia Department of Natural Resources is donating 1,300 baby trees — at 45 to 60 centimetres, they're taller than the average seedling — for replanting efforts.

The trees are at a provincial nursery in Inverness, though the seeds came from the Halifax area, said department spokeswoman Angela Campbell.

One thousand are available for Point Pleasant, and another 300 for private properties from which trees were removed under orders from the food inspection agency. Over 900 trees have been cut outside the park because of fears of the brown spruce longhorn beetle.

Just how many trees will be replanted in the park has yet to be decided, said Stephen King, senior parks adviser for Halifax Regional Municipality.

Representatives from the municipality, Parks Canada (which holds the park lease), the city's Point Pleasant Park advisory committee, the task force that ordered the cutting, and other groups meet this week to try to establish a park restoration committee.

Mr. King said even the Friends of Point Pleasant Park are welcome. That citizens' group won a temporary injunction against the cutting, but lost a court challenge last December aimed at halting the work permanently.

But spokesman Iain Taylor said Monday the group hasn't been approached about participating.

And he said members will likely stay outside the process and keep a critical eye on it.

The court battle has "kind of drawn the line in the sand. Hopefully, we can go beyond that," Mr. King said.

He said restoration plans must be finalized soon, so work can begin this spring.

It may involve augmentin poor soil with municipal com post, and testing the addition o dolomitic limestone in som areas to offset acidic soil.

Students from Prince Andrev High School in Dartmouth ar keen to plant trees and they ma also help develop interpretiv park signs.

Student Kelly Hogg of th Prince Andrew Woodlawn Envi ronmental Enhancement Conservation Association sai the group has chosen May 3 for planting ceremony that al Grade 12 students will partic pate in.

Jim Murphy, chairman of th Point Pleasant Park advisor committee, said more rules o park use aren't the answer bu they should be streamlined s they're understood and obeyed.

"The park is under a numbe of stresses, and I think that's a reflection of the fact the city i getting bigger, and more people are using it," he said.

"But that's not saying that don't think the beetle's causing the damage."

Mr. Simpson said he saw lots of seedlings in the park last year — evidence of regeneration.

At first they grow slowly, and it can take 50 years for a red spruce to reach 10 metres, he said.

Figure 10. Article that appeared in Chronicle Herald.

Talk about being resourceful. The Canadian Forest Service has collected enough red spruce seeds to replant beetle-infested Point Pleasant Park 100 times over.

When the Canadian Food Inspection agency announced plans to cut down thousands of park evergreens due to a foreign beetle infestation, a sister agency, the Canadian Forest Services, collected seeds from the park last fall.

The seeds remain in the cones in Fredericton, where they'll be stored in mason jars, in walk-in freezers held at the correct temperature to ensure survival.

And while they can last in storage for 50 years, it's still too soon to say whether they'll ever find their way back to Point Pleasant Park. There are already plans to plant baby trees now being stored at a provincial nursery in Inverness.

Still, it's comforting to know forestry officials had the foresight to salvage so many seeds, just in case they may be needed.

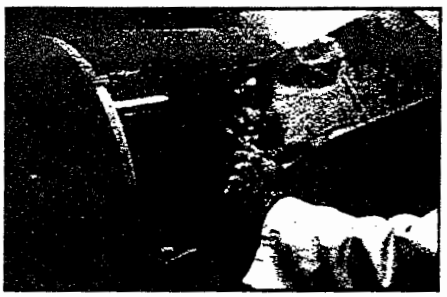
Figure 11. Article that appeared in Sunday Herald.

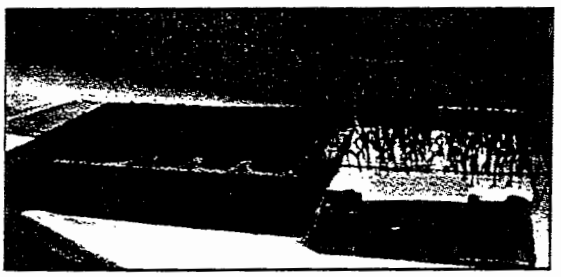
Regard sur le Centre national des semences d'arbres

Ressources naturelles Canada assume la responsabilité de notre Centre national des semences d'arbres, qui est situé à Fredericton au Service canadien des forêts - Centre de foresterie de l'Atlantique.

Le Centre est le seul du genre au Canada dont le mandat national est d'obtenir et de conserver des semences d'arbres et d'arbustes. Sur demande, le personnel fournit des semences d'origine et de qualité reconnues à des chercheurs du monde entier aux fins de recherches.

De plus, le Centre travaille activement à la conservation de gènes d'espèces d'arbres et d'arbustes indigènes du Canada. L'objectif à long terme est de conserver des échantillons représentatifs, tirés des aires naturelles, de toutes les essences canadiennes.





Les demandes de semences, en majorité, portent sur des essences indigènes du Canada. Les recherches se font soit sur les semences elles-mêmes, soit sur des plants que l'on fait pousser pour les planter dans des parcelles d'essai. Les semences sont envoyées à des chercheurs dans les universités canadiennes et dans des centres fédéraux et provinciaux ainsi qu'à des organismes dans d'autres pays du monde.

Le rôle de la conservation des gènes prend une importance de plus en plus grande. En effet, à mesure que les peuplements naturels sont exploités, on replante de plus en plus sur les sites des plants obtenus à partir de semences recueillies dans des vergers à graines.

OBTENIR DES SEMENCES VARIÉES

Donc, on ne recueille que très peu, sinon pas du tout, de semences dans des peuplements naturels. Or, il est important d'obtenir des semences d'une grande variété de peuplements naturels afin de maintenir la diversité génétique des espèces en vue d'études et de recherches ultérieures.

En outre, il est important de recueillir et de conserver des semences de populations naturelles qui pourraient être uniques ou être menacées ou en danger d'une façon ou d'une autre.

On obtient les semences de diverses façons. En très grande partie, les semences sont recueillies par le personnel du Centre, mais on en obtient également grâce à la collaboration d'autres centres du Service canadien des forêts, des services forestiers provinciaux, des entreprises forestières et d'autres organismes, ou encore par voie d'échanges, d'achats ou de dons.

Les semences sont recueillies dans des peuplements naturels ou des plantations dont on connaît l'origine des semences. On recueille normalement les semences lors des années favorables afin que les semences soient de haute qualité et auprès d'un certain nombre d'arbres afin que l'échantillon génétique soit représentatif de la population.

Le Centre a des semences d'une centaine d'essences d'arbres et d'arbustes du Canada ainsi que d'une centaine d'essences exotiques pour un total de plus de 11 000 placettes individuelles.

Suite en page 24

Figure 12. Article that appeared in Nos Forêts.

Regard sur le Centre national des semences d'arbres

Suite de la page 15

UN TRAITEMENT MINUTIEUX DES SEMENCES

Les semences sont traitées, nettoyées, testées et conservées dans des bocaux de verre de diverses grandeurs, selon la quantité et la taille des semences.

Presque toutes les semences sont conservées à -20° C; à cette température, elles peuvent se conserver pendant de nombreuses années pour peu que la teneur en humidité soit basse.

Les semences de certaines essences de feuillus, notamment le chêne et l'érable argenté, ne peuvent être conservées longtemps et ne peuvent pas non plus être congelées. On les conserve à +4° C et on en recueille fréquemment afin que le stock de ces semences soit toujours viable.

Les semences conservées comme il se doit restent viables pendant longtemps. Par exemple, les semences d'un certain nombre d'essences, notamment l'épinette blanche, l'épinette noire, le pin gris et le pin rouge, ont germé dans une proportion de 65 à 85 p. 100 après avoir été conservées dans un entrepôt frigorifique pendant plus de 40 ans. Il importe de savoir que les semences vivront longtemps; donc, si elles sont recueillies dans des populations uniques ou des peuplements menacés d'une façon ou d'une autre, elles peuvent être conservées pour l'avenir.

Important : Le personnel du Centre des semences aimerait avoir des commentaires de gens qui connaissent des populations d'essences indigènes telles que le frêne noir ou de très vieux peuplements d'autres essences. Tout renseignement sur l'endroit de ces peuplements aidera le personnel à recueillir de bonnes semences.

Pour se renseigner à ce sujet, prière de communiquer avec Dale Simpson au (506) 452-3530, courriel dsimpson@nrcan.gc.ca, ou avec Bernard Daigle, au (506) 452-3289, courriel bdaigle@nrcan.gc.ca.

Figure 12 (continued). Article that appeared in Nos Forêts.

COLLABORATION WITH COLLEAGUES

Ontario Seed Plant (red pine)

Two samples of red pine seed (Seedlot No's 3835 and 3839) collected in 2000 were received in September from the Ontario Tree Seed Plant. The seed was sent as a result of 1 to 2 month-old seedlings grown from Seedlot 3839 dying at the Kemptville Nursery. Seedlot 3835 was sent for comparison purposes. The seedlots were evaluated for purity, moisture content, germination, and seed was x-rayed. Purity of both seedlots was excellent (100 %) and the moisture content of the seed, 6.86 and 7.72 %, was within the limit of acceptable values (5 - 8 %). A random sample of seed was x-rayed from each seedlot to evaluate the maturity of embryos as evidenced by their length. All seed from both seedlots had well developed mature embryos that fully occupied the length of the corrosion cavity. A paired germination test was conducted for each seedlot consisting of seed that was stratified and seed that was not stratified. For the "comparison" Seedlot 3835, the stratified seed initially germinated faster than the unstratified seed but the differences between the two treatments disappeared by Day 13. The results were significantly lower than those achieved by the Ontario Tree Seed Plant 7 months earlier. Possible explanations are: the seedlot lost some vigor over the intervening months, different germination criteria, or sampling error. The attached documentation reported the first cones were received at the Seed Plant September 7, 2000. It is possible some of the cones were collected a bit early. The seed from these could germinate quite well initially but the long-term storability could decline rapidly. Both treatments exhibited about the same proportion of low vigor seed (22.5 and 23.0 %). For Seedlot 3839, stratified seed initially germinated faster than unstratified but by Day 13 the differences were not as great with unstratified seed having a higher germination percentage on this day. Germination was essentially complete by Day 15 for unstratified seed. Total germination of the stratified seed is 3% lower than that of the test conducted at the Ontario Tree Seed Plant. There was more low vigor seed at Day 21 for the stratified seed while the unstratified seed had more fresh seed. In conclusion, germination of Seedlot 3839 (identified as the "problem" seedlot at the nursery) is consistent with the test conducted at the Ontario Tree Seed Plant. Apparently the seed had germinated well in the nursery beds and the seedlings were growing well prior to death. As well, white pine seedlings in adjacent seedbeds were still alive. This leads to the assumption of a variance in nursery practices. The significant decline in germination of Seedlot 3835 is a surprise. Seed vigor is certainly lower than what was experienced at the Ontario Tree Seed Plant. Such a marked decline is something that one would not expect to see in red pine. Possibly some of the cones were collected too early.

Fredericton Parks and Recreation (white elm)

Collaboration with city of Fredericton Parks and Recreation staff through Don Murray was instrumental in having seed collected from a number of white elm trees suspected to be resistant to Dutch Elm Disease. An additional activity was the collection of cuttings from these trees for rooting. The City plans to plant more native elm and would prefer to plant trees that may be resistant to the disease. Once the cuttings have rooted and become established they will be transferred to the City for growing to a larger size as well as CFS retaining some for testing for disease resistance. Cuttings were collected June 6 and July 12 but unfortunately they did not root. The project will be repeated in 2002

Petawawa Research Forest (seed trap experiment)

Seed Centre staff collaborated with colleagues at Petawawa Research Forest in the germination of seed collected in a seed trap experiment. Seed from red pine and white pine was collected using seed traps from August 2000 to February 2001. Seed were sent to the Seed Centre for germination testing in June and July. A total of 58 germination boxes were used and an average of 6 to 10 seedlots were placed in each box. Approximately 400 germination tests were performed.

Chinese Delagation (Gao Chang Qi)

Staff at NTSC was involved with the visit of a delegation of Chinese from Jilin province in China (Gao Chang Qi and colleagues). Visits included a tour of the Fraser Nursery in St-Joseph de Madawaska, a stop at a white pine stand near Miramichi, yellow birch management in Prince Edward Island, and visits to the Atlantic Seed Centre and Tree Improvement Program at Kingsclear, and our Seed Centre.

SEED CENTRE STAFF

Staff at the NTSC consisted of one full-time seed technologist (Bernard Daigle) and a second-year forestry student (Lise Marchand) who was hired for 15 weeks (May – August). Staff is under the supervision of the National Forest Genetics Resources Manager, Mr. Dale Simpson.

The Seed Centre again benefited from outside help during 2001:

Garry Scheer continued to assist with the germination of white spruce seedlots. He contributed an average of 3 days/week for the months of January and February.

Chris McLaughlin completed his assignment. He worked from January 1 to Febraury 28.

Kim Donaher, an intern from the YMCA Youth Intern Program, worked on and off from February to the middle of September. Kim was made available by Dr. Tannis Beardmore.

The extra help, (which amounted to about 32 weeks) enabled the Seed Centre to continue to catch up with the tremendous backlog of work.