National Tree Seed Centre

Annual Report

2003

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Natural Resources Canada
Canadian Forest Service - Atlantic
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EXECUTIVE SUMMARY

Activities conducted during the winter of 2003 focussed on processing and testing the seed collected in 2002. Some help was provided to assist with the processing of 40 balsam fir (*Abies balsamea*), 15 bracted balsam fir (*Abies balsamea* var. *phanerolepis*), and 77 eastern hemlock (*Tsuga canadensis*) seed lots.

The seed crop in 2003 was not very good. Only 69 collections from 10 species were made. Seed was collected from Québec, Prince Edward Island, and New Brunswick. In June several collections of black willow (*Salix nigra*) were made which represented the first collections of this species the by the Seed Centre.

During 2003, a total of 89 requests representing 1 120 seed lots was processed. The majority of the requests were from Canada but seed was also sent to China, Greenland, Hungary, Norway, Portugal, Spain, Sweden, and the United States. The Seed Centre web site, which is part of the Atlantic Forestry Centre web site, continues to be popular. In 2003, the site received over 700 000 hits on its web pages. The web site is generating new clients and the number appears to be growing.

Seed testing in 2003 consisted of approximately 1000 germination tests, 403 moisture content tests, and 400 thousand seed weight tests.

Several large experiments were undertaken. A sugar maple (*Acer saccharum*) experiment using seed lots from Ontario, Quebéc, and New Brunswick showed that seed from New Brunswick is more dormant requiring 12 weeks of chilling as opposed to 8 weeks for the Ontario and Québec sources. Another experiment, evaluating chilling and germination temperature requirements of eastern hemlock seed, demonstrated that 20 weeks chilling and germination at 15°C resulted in optimal germination. Other experiments included silver maple (*Acer saccharinum*) and white elm (*Ulmus americana*) storage, and alcohol separation and tolerance tests of white birch (*Betula papyrifera*) and eastern hemlock seed.

Two undergraduate thesis projects were carried out by fifth-year forestry students at the University of New Brunswick using the Seed Centre facilities. One thesis, prepared by Shane MacLeod compared two viability tests: tetrazolium and excised embryo with a standard germination test on seed of American mountain ash (*Sorbus americana*) and showy mountain ash (*Sorbus decora*). Both viability tests overestimated actual germination. The second thesis by Kirk Ellis evaluated chilling requirements and germination temperatures of American beech (*Fagus grandifolia*) seed. Best results were obtained by chilling seed for 12 weeks and germinating them at 10/20°C.

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INTRODUCTION

This report is the sixth covering the activities of the National Tree Seed Centre (NTSC). Similar reports were prepared from 1998 - 2002. The purpose is to provide a summary of the activities of the NTSC for 2003. 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 synthesized and reported.

The NTSC is a major component of the National Forest Genetic 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, N.B. 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 for gene conservation.

Seed is stored in four different categories: Seed Bank, Reserved, Tree Breeding, and Gene Conservation (Table 1). The total number of seed lots increased by 316 to 11 686 in 2003.

Table 1. Seed stored at the NTSC as of December 31, 2003.

Seed Bank		Reserved		Tree Breeding		Gene Conservation	
# Species	# Seed lots	# Species	# Seed lots	# Species	# Seed lots	# Species	# Seed lots
193	4 637	42	1 956	34	3 522	9	1 565

Seed Bank seed lots are the active collection 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, 2003, the NTSC Seed Bank had 122 Canadian species (4 300 seed lots) in storage (Table 2). An additional 85 exotic species (337 seed lots) are also stored. Exotic species are defined as those that were collected outside Canada which may or may not be present in Canada. 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.

Since the Seed Centre moved to Fredericton, staff have concentrated their efforts in acquiring collections from N.B., Nova Scotia (N.S.), and Prince Edward Island (P.E.I.). Travel beyond the Maritime provinces is difficult due to limited resources (staff and budget). There is an ongoing effort to acquire seed from other provinces and Seed Centres whenever the opportunity presents itself. The NTSC needs to continue in its effort of acquiring seed lots west of Ontario. Since collections by NTSC staff are unlikely due to distance and costs, these seed lots will have to be purchased or obtained through donation.

Table 2. Number of species, number of seed lots, and percentages by province stored in the Seed Bank category.

Province	# Species	# Seed lots	%
Alberta	11	50	1.2
British Columbia	30	286	6.7
Manitoba	6	53	1.2
New Brunswick	68	974	22.6
Newfoundland	11	76	1.7
Nova Scotia	40	357	8.3
Ontario	59	1 546	35.9
Prince Edward Island	30	91	2.1
Québec	15	762	17.7
Saskatchewan	8	77	1.8
Yukon Territory	2	35	0.8
Total		4 300	100

The Reserved category contains seed lots that have been reserved by researchers. Many of these seed lots were collected for special projects. One hundred and fifty-six seed lots were removed from Reserved and placed in the Gene Conservation category. These seed lots consisted of white spruce from Manitoulin Island in Ontario. The quantities are similar to the white spruce seed lots moved from Tree Breeding to Gene Conservation in 2000. Also, in 2003, one hundred and fifty-seven seed lots which were reserved for Ben Wang, Petawawa Research Forest (PRF) were returned to Ben. Some clean-up of this category is still necessary but remains a low priority.

The Tree Breeding category is composed of seed lots that originated from the genetics program at PRF and were transferred to the Seed Centre for storage. The quality of many of these seed lots, which are still being stored at 4°C, is uncertain and they must be tested before being stored at -20°C. As testing progresses, the better quality Tree Breeding seed lots are moved to the Seed Bank category. There was no activity with the Tree Breeding seed lots in 2003.

The Gene Conservation category was put in place to assure that genetic material obtained from rare, endangered, and/or unique populations is preserved. At present, these seed lots are composed mainly of white spruce (1 544 out of 1 565) seed lots from the range-wide white spruce (*Picea glauca*) provenance collections which were made in cooperation with PRF in the mid to late 1970's including the 156 seed lots from Manitoulin Island which were added in 2003. 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 seed lots are also stored in the Seed Bank (-20°C) and Tree Breeding (4°C or -20°C) categories.

SEED COLLECTIONS IN 2003

Seed production was very poor in 2003. In order to ensure good quality seed, seed is only collected during good seed years. Seed collected in poor seed years may be of lesser quality because of poor pollination. Also, the time required to collect sufficient seed increases when there is a poor seed crop. Therefore, only 69 seed lots were collected in 2003 compared to 367 seed lots in 2002.

In June several collections of black willow (*Salix nigra*) were made in the Hampstead, N.B. area. The collection area was on the east side of the Saint John River at the Hampstead ferry crossing. Even though the seed were collected while the catkins were actively shedding, the yield was not as good as expected. A follow-up collection in the same area should be carried out in 2004.

Other collections of note included 28 single-tree jack pine (*Pinus banksiana*) collections from Saint Sosime (Harcourt area), N.B.; 7 sugar maple (*Acer saccharum*) collections from Duchesnay, QC.; 7 black cherry (*Prunus serotina*) collections from Forks Stream, N.B.; and 2 red pine (*Pinus resinosa*) collections from P.E.I. Table 3 provides a complete list of the collections made in 2003.

Table 3. Seed collections made by Seed Centre staff in 2003.

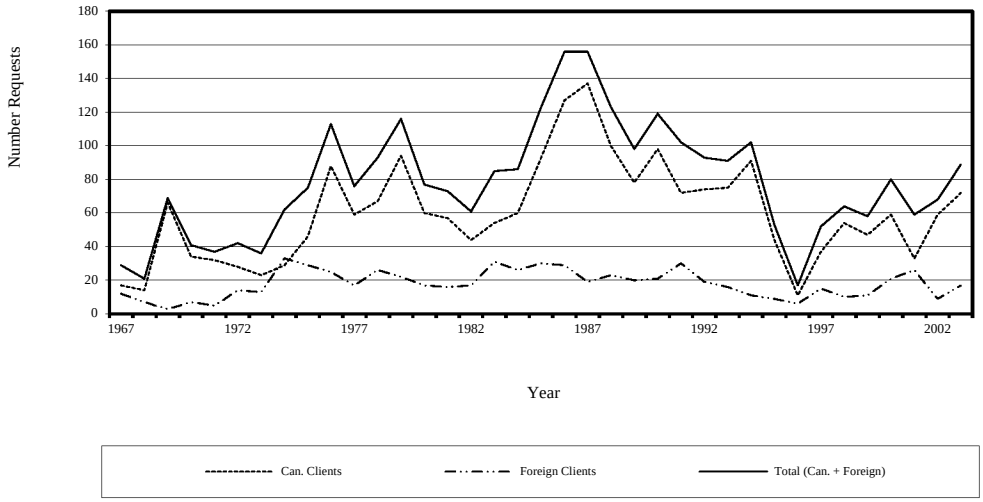
Species	N.B.	QC	P.E.I.	Total
Acer saccharinum	4			4
Acer saccharum		7		7
Alnus viridis ssp. crispa			2	2
Nemopanthus mucronatus			1	1
Pinus banksiana	27			27
Pinus resinosa			2	2
Pinus strobus	6		7	13
Prunus serotina	7			7
Quercus rubra	1			1
Salix nigra	5			5
Total	50	7	12	69

In addition to the seed collected by Seed Centre staff, several seed lots were acquired through donations from various organizations: Weyerhaeuser Saskatchewan Ltd. 5 white spruce, 4 black spruce (*Picea mariana*), and 4 jack pine, Québec Ministère des ressources naturelles in Berthierville (2 sugar maple), Ontario Ministry of Natural Resources (2 sugar maple), Manitoba Department Natural Resources (2 black spruce, 7 white spruce), and 100 limber pine (*Pinus flexilis)* from Canadian Forestry Service - Edmonton, Alberta.

SEED REQUESTS

During 2003, an effort was made to capture the information on seed requests between 1967 and 1982. These records had never been entered in the database. Unfortunately many of the records contained incomplete information which sometimes meant that some records could not be included. The main reason was absence of species names.

Although the ledger did not always provide details of the species, seed lots and quantities, it did provide fairly accurate information on the number of requests and number of seed lots that were shipped as well as where the seed were shipped. Since 1967, the NTSC has filled 2 895 requests from clients around the world (average 78/year). Figure 1 shows the annual number of seed requests that have been filled since 1967. Most of the requests (77%) have been from Canada but there has been a steady demand for seed from outside Canada. Since 1967 seed has been shipped to clients in 62 countries. Requests from foreign clients began to increase in the early 1970's and remained fairly constant at about 25/year until the early 1990's during which there was a steady decline but since the 1990's, the number of requests has returned to the previous numbers. The sharp decrease that occurred in 1996 coincided with the relocation of the NTSC from Petawawa to Fredericton.



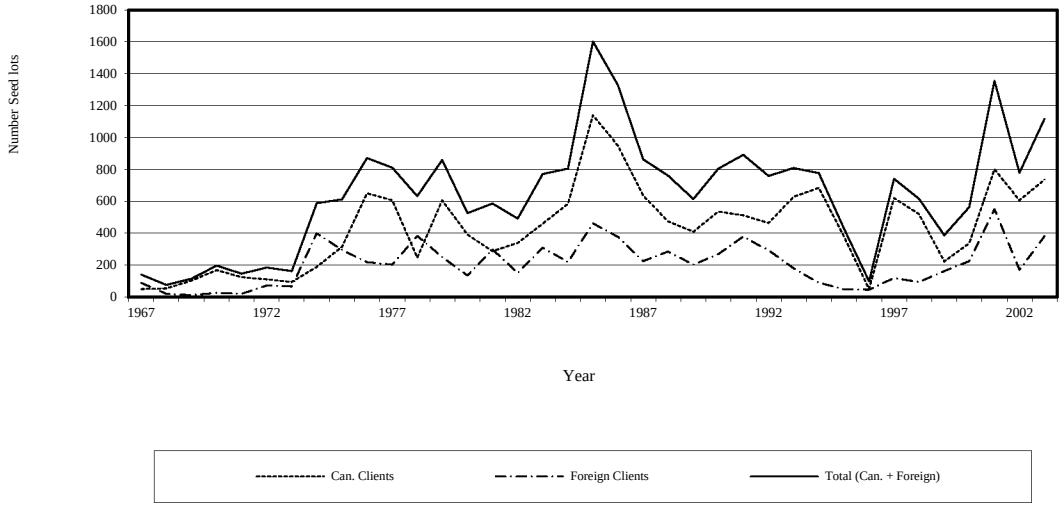


Figure 1. Number of seed requests between 1967-2003.

Another measure of the use of the NTSC by clients is the actual number of seed lots shipped to clients. This ranges from a single seed lot to hundreds (average 8.3 seed lots/client). The average number of seed lots provided to clients since 1967 has been 646/year. Figure 2 shows the number of seed lots sent to Canadian and foreign clients since 1967. As was the case with the number of requests, Canadian clients received most of the seed. However, the seed orders from foreign clients were higher (11.8 seed lots/request) compared to 7.2 seed lots/request for Canadian clients. The sharp drop in the number of seed lots in 1996 was again the result of the NTSC being relocated to Fredericton from Petawawa.

Figure 2. Number of seed lots sent to clients between 1967-2003.

It is the Seed Centre's policy to provide seed at no cost for scientific research. Seed is also provided on occasion to universities and other educational institutions for educational purposes and to arboretums. A seed request form must be completed by the client before a seed order is processed. The purpose of this form is to gather information on the type of research being carried out and to serve as a means of screening requests. All seed requests received from outside of Canada are referred to the Canada Food Inspection Agency to determine if phytosanitary certificates and/or import permits are required.

Table 4. Number of requests and number of seed lots shipped by country in 2003.

Country	# Requests	# Seed lots
Canada	72	738
China	2	201
Greenland	1	4
Hungary	1	1
Norway	1	21
Portugal	1	34
Spain	1	2
Sweden	1	10
United States	9	109
Total	89	1 120

During 2003 a total of 89 requests representing 1 120 seed lots was processed. The majority of the requests were from Canada but seed was also sent to China, Greenland, Hungary, Norway, Portugal, Spain, Sweden, and the United States (Table 4).

SEED TESTING

Germination tests are performed on all freshly collected seed lots as well as seed lots in storage that have not been tested for several years. In most cases, due to small seed lot size, four replicates of 50 seed each are placed on moistened Kimpak in germination boxes. When larger seed is being tested, the number of seed is usually reduced. **Four hundred and thirty-seven germination tests** were carried out in 2003. In addition, approximately 550 germination tests were carried out as part of special projects and experiments.

Figure 3 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 coincided with the transferring of the Seed Centre from Petawawa to Fredericton.

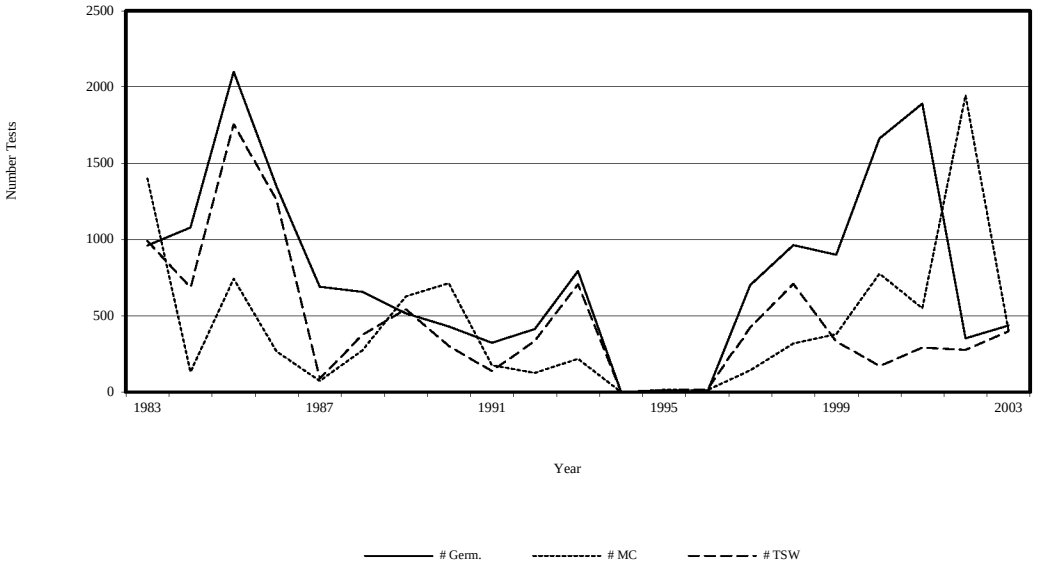


Figure 3. Number of germination tests (# Germ), moisture content tests (# MC), and thousand seed weights (# TSW) carried out by the NTSC since 1983.

The target moisture content for orthodox seed is between 5 and 8 %. Seed that are above this range are further dried before being stored. **Four hundred and three moisture content determinations** were carried out in 2003.

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 **four hundred 1000-seed weights** was done in 2003.

There are several reasons for the relatively low numbers of the various tests that were performed in 2003. Most of the testing is usually carried out during the winter months or by summer students during the summer. Processing of seed collected in 2002 continued until late May and our budget was insufficient to hire a student. Several large experiments were undertaken in 2003. Two experiments in particular: sugar maple and eastern hemlock, required considerable amounts of time. The moisture content determinations carried out as part of these experiments are not included in the reported numbers.

Alcohol Tolerance Test for Eastern Hemlock

The Seed Centre has used 100% ethanol to increase the quality of conifer seed since 1996. Ethanol is used to separate filled seed from empty, partially filled, and insect infested seed. This is possible due to the low specific gravity and low surface tension of ethanol. One obvious concern is the effect that ethanol may have on the germination and vigour of the seed. An alcohol tolerance test done on white birch seed showed that seed immersed in ethanol for 3 minutes had lower vigour than the control even though overall germination wasn't affected (Daigle and Simpson, 2002). Eastern hemlock seed has been treated with ethanol in the past but the effect of the treatment is not known.

A single seed lot of eastern hemlock with good germination was immersed in alcohol for 15, 30, 45, 60, 120, 180, 240, 300, 600, and 900 seconds. The seed were then rinsed in tap water for 15 seconds and laid out to dry in paper coffee filters in the lab at 22°C and 20% RH for 24 hours. Four replicates of 50 seed each were then placed on moistened Kimpak in Petawawa germination boxes and moist chilled for 16 weeks. Following chilling, the seed were placed in a germination cabinet for four weeks at 15°C constant under a 24 hour cycle of 8 hours with light and 16 hours in dark and at a constant RH of 85%.

Germination was assessed every 7 days. Figure 16 shows the results for fully germinated seed which is defined as seed with good radicle and hypocotyl development and with the cotyledons beginning to separate from the seed coat. Results indicated considerable variation for the different time periods that the seed were immersed in alcohol. Germination for the control was 81.5% while the average germination for all of the alcohol treatments was 71.5% which would indicate that alcohol may be damaging the seed. However, germination ranged from a low of 61.5% for seed immersed for 30 seconds to a high of 84.0% for seed immersed for 600 seconds.

The seed used in this study was collected in 2000 and had been in frozen storage at the NTSC for two years. The seed had been treated with alcohol to remove empties prior to being stored. This means that the control is not a true control. Although it does not appear that alcohol damages the seed, a more in-depth study using a true control (seed that has never been immersed in alcohol) and storing the treated seed for a period of time to assess long-term effects of alcohol treatments would provide a clearer picture.

A paired study to determine which of alcohol separation and air aspiration improves the seed quality the most would be useful. One disadvantage of air aspiration is the removal of small filled seed.

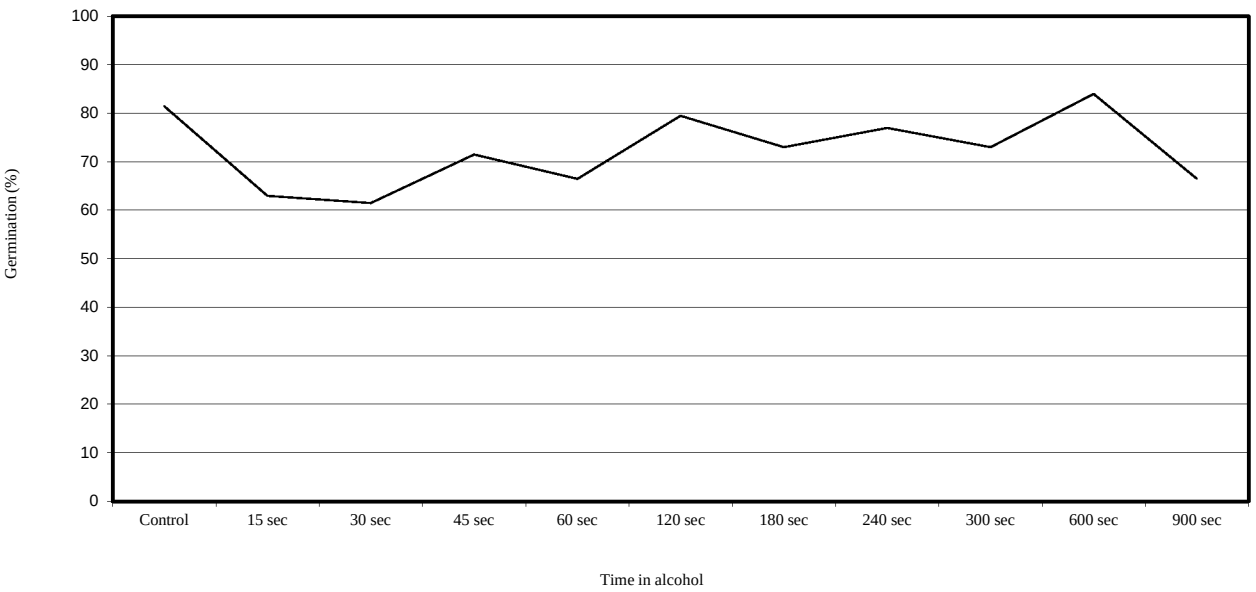


Figure 16. Germination of eastern hemlock seed immersed in ethanol for 15, 30, 45, 60, 120, 180, 240, 300, 600, and 900 seconds.

Daigle, B.I., and J.D. Simpson. 2002. National Tree Seed Centre annual report 2001. Nat. Res. Can., Can. For. Serv. – Atl., 46 p.

White Birch De-winging

Twenty-three single-tree white birch (*Betula papyrifera*) seed lots were collected from 4 sites in New Brunswick (Catamaran Brook, Clair, Coy Brook, and First Eel Lake) and 1 site in Nova Scotia (North Twin Lake) in 2002. All collections were made in areas with good catkin production. Following collection, the catkins were allowed to air dry and the seed were processed by breaking apart the catkins and separating winged seed and bracts by sieving and air aspiration.

Germination tests were performed on the winged seed. Four replicates of 50 seed each were placed on moistened Kimpak in Petawawa germination boxes and germinated at 20/30°C for 21 days. A second sample was de-winged by gently rubbing in a cloth bag. Seed were separated from the crushed wings by sieving and air aspiration. The seed was then floated in ethanol to separate filled from empty seed. The seed were rinsed in tap water and dried at ambient room conditions of 21°C and 20% RH for 24 hours. Germination tests were performed on the de-winged + alcohol separated seed using the same method used for the winged seed.

Germination results indicated that de-winging and using ethanol to separate filled from empty seed greatly improves germination. A wide variation in germination of the winged seed is evident in Table 8. Mean germination for all winged seed lots was 32.2% with germination ranging from 0.0% to 60.0% while germination of the de-winged + alcohol separated seed was much better with a mean germination of 81.8% and a range of 41.0 to 97.0%.

Although the production of catkins was similar in all of the collection sites, production of viable seed as evidenced by the germination results of the winged seed, varied greatly. The poorest seed set occurred at the Coy Brook site where an average germination of 2.7% over 5 trees was observed. Average germination after treatment was increased to 64.4%. In general, germination of winged seed was either poor or relatively good depending on the site (Figure 17). The exception was the Clair site where seed from 2 trees had good germination (29.5 and 38.0%) and 2 trees had very poor germination (0.5 and 1.0%).

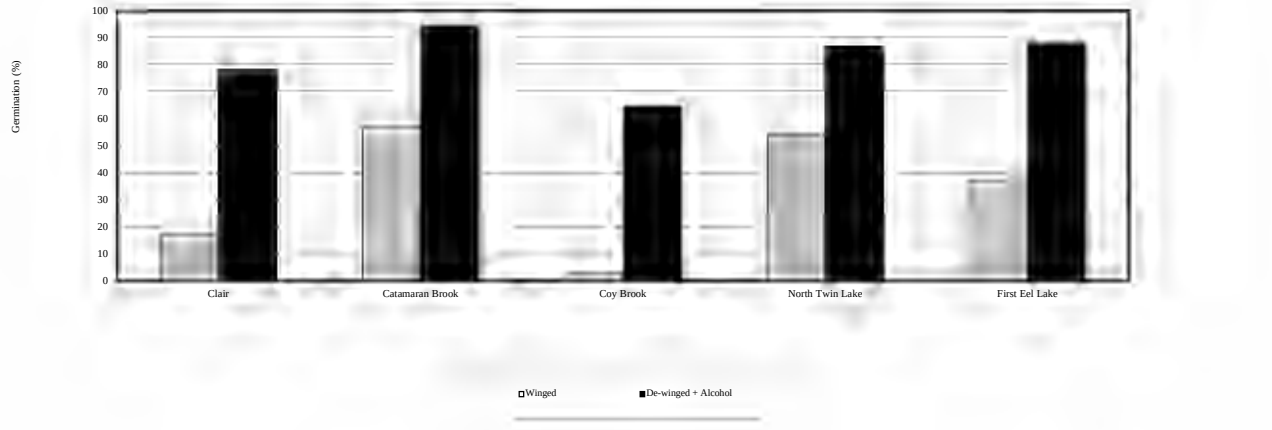


Figure 17. Comparison of germination (%) of winged and de-winged white birch seed collected from 5 sites in New Brunswick and Nova Scotia.

Table 8. Results of germination tests of winged and de-winged + alcohol separated white birch seed from 5 sites in New Brunswick and Nova Scotia.

Species	Seed lot	Provenance	Winged	De-winged + Alcohol
Betula papyrifera	20021095	Clair	38.0	91.5
Betula papyrifera	20021096	Clair	1.0	93.5
Betula papyrifera	20021097	Clair	29.5	86.5
Betula papyrifera	20021098	Clair	0.5	41.0
Betula papyrifera	20021099	Catamaran Brook	58.5	92.5
Betula papyrifera	20021100	Catamaran Brook	54.0	94.0
Betula papyrifera	20021101	Catamaran Brook	-	91.0
Betula papyrifera	20021102	Catamaran Brook	57.5	96.5
Betula papyrifera	20021106	Coy Brook	0.0	71.0
Betula papyrifera	20021107	Coy Brook	4.5	45.0
Betula papyrifera	20021108	Coy Brook	1.0	55.0
Betula papyrifera	20021109	Coy Brook	4.0	85.0
Betula papyrifera	20021110	Coy Brook	4.0	66.0
Betula papyrifera	20021114	North Twin Lake	72.5	95.0
Betula papyrifera	20021115	North Twin lake	71.5	92.0
Betula papyrifera	20021116	North Twin lake	47.5	65.5
Betula papyrifera	20021117	North Twin lake	24.5	90.5
Betula papyrifera	20021118	North Twin Lake	54.5	90.5
Betula papyrifera	20021119	First Eel Lake	40.5	87.5
Betula papyrifera	20021120	First Eel Lake	29.0	88.5
Betula papyrifera	20021121	First Eel Lake	47.5	78.5
Betula papyrifera	20021122	First Eel Lake	60.0	87.0
Betula papyrifera	20021123	First Eel Lake	7.5	97.0

There are several observations that can be made based on the results that were obtained. The first is that good catkin production does not guarantee good production of viable seed. The reason for poor reproductive success is unknown but may be the result of poor pollination as there was no great evidence of insect or disease damage on the seed. A second observation is that collections should be made from single trees. The great variation in seed viability among trees in the same stand would greatly bias a bulked collection.

The advantages gained by treating the seed are definitely worth the effort. The obvious advantage is higher germination, but another advantage is more efficient storage of seed. The volume required to store untreated winged seed is 10 - 20 times greater. Finally, as discussed in an earlier report by Daigle and Simpson (2002), de-winging and immersion in alcohol does not appear to damage the seed.

Based on these results, the NTSC will continue to treat freshly collected white birch seed in this manner.

Daigle, B.I. and J.D. Simpson. 2002. National Tree Seed Centre annual report 2002. Nat. Res. Can., Can. For. Serv.-Atl., 38p.

Silver Maple Storage Experiment

The purpose of this storage experiment was to determine the effects of storage temperature on the survival and germination of silver maple (*Acer saccharinum*) seed. Four collections of silver maple seed were made on June 11, 2003. Two collections were made at Maugerville, N.B. (old road along the Saint John River near the Burton Bridge) and the other two were made along the old Trans Canada Highway at a rest stop at Sheffield, N.B. All were single-tree collections and made using a bucket truck. Seed had already started to drop from most of the trees in the area.

Germination of silver maple seed decreases rapidly when MC drops below 38% and best germination occurs when the MC of the seed is above 43% (Daigle and Simpson, 2002). The seed were brought into the lab and laid on large screen trays to dry. Moisture content (MC) was determined after the seed had been cleaned (24 hours after collection). The MC of the fresh seed averaged 54.2% (range of 49.8–58.0%). Moisture content of the seed was closely monitored and when the MC reached 45% (average), the seed were put in storage. Germination, thousand-seed-weight, and MC tests were carried out on the fresh seed just prior to storage (Table 9).

Table 9. Moisture content (%) and germination (%) of fresh seed from 4 silver maple seed lots.

Seed lot	Moisture Content (%)			Germination (%)	
	Fresh seed	Dried seed			
	winged	winged	de-winged	Winged	De-winged
20031000	58	42.8	45.2	90	88
20031001	52.2	43.6	44.4	82	83
20031002	49.8	-----	42.6	-----	89
20031003	56.7	-----	47.7	-----	94

All seed lots were de-winged when the wings became dry enough to break off without damaging the seed (moisture content of about 45%). A small sample of seed from two of the seed lots was not de-winged. This will allow a comparison to determine if there are any negative effects of de-winging. De-winged seed had a higher MC than winged seed (about 2% on average). This makes sense as the wings were drier than the rest of the pericarp and the actual seed. Since MC in the past had always been calculated using the complete winged seed, the MC had to be monitored to make sure the seed were not dried excessively. The de-winged seed were then sieved and blown in an air aspirator to remove the wings and other light debris. This process greatly reduced the storage volume and if the process does not damage the seed may eliminate the need for manual cleaning of the seed.

Sufficient seed was processed to allow for ten samples from each seed lot to be stored at three different storage temperatures (3°C, -1°C, and -5°C). One hundred and thirty de-winged seed from each seed lot, were placed in 125 ml Mason jars and sealed with parafilm. Samples of winged seed from two of the seed lots were treated in a similar manner and were be stored at -1°C. This will allow germination testing of 4 replicates of 25 seed and determination of MC at each storage temperature. On June 19, the seed were placed in a walk-in cooler at 3°C. On June 24, the seed that were to be stored at -1°C and -5°C were moved to an incubator set at -1°C. On July 3, the sub-set which was to be stored at -5°C was moved to a walk-in cooler set at -5°C. This step by step procedure was used to gradually condition the seed to mitigate the impact of the lower storage temperature.

Results from germination testing carried out after 6 months storage are presented in Table 10. Germination decreased for all seed lots at all storage temperatures. Seed viability was best at -1°C followed by 3°C. Seed stored at -5°C showed the poorest results. Moisture content did not change for seed stored at -5°C while MC increased for seed stored at -1°C and 3°C with the seed stored at 3°C having the greatest increase.

Table 10. Moisture content (%) and germination (%) of de-winged fresh seed silver maple seed and after 6 months storage at 3 temperatures.

	Fresh Seed		After 6 months storage					
			3°C		-1°C		-5°C	
Seed lot	MC	Germ	MC	Germ	MC	Germ	MC	Germ
20031000	45	88	49	65	49	58	46	25
20031001	44	83	51	20	49	71	46	0
20031002	43	89	49	0	47	66	43	7
20031003	48	94	53	32	51	29	46	2
Average	45	89	51	29	49	45	45	9

It appears that -5°C is too cold for storage of silver maple seed. However, it may be possible to store silver maple seed at -5°C if the MC was lower. Based on the condition of the seed, it appears that the pre-storage MC may have been too high. It would be useful to test a storage temperature of -3°C and a slightly lower moisture content. If large quantities of seed are stored it may be beneficial to periodically remove the seed from storage and test the moisture content. If the MC is high, the seed could be conditioned to bring them back to the proper MC.

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White Elm Storage Experiment

Five single-tree collections of white elm (*Ulmus americana*) were used in the experiment to determine the effect of removing or partially removing the wing from white elm achenes. Although Young and Young, (1992) warn against de-winging of elm seed because of potentially damaging the seed, it was decided to try de-winging to determine if this was indeed the case. The advantages of de-winging include a greater capacity for storage, a reduction in air space in the containers, and removal of partially filled and empty seed. The five seed lots selected were collected on June 6, 2001 in Fredericton, N.B. All collections were made using a "bucket truck". The collections were made by staff from the Seed Centre 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 damage the seed. De-winging was facilitated when seed moisture content (MC) was below 8%. Seed that were too moist tended to form a matted ball and were difficult to process. Moisture contents were determined and seed lots with MCs above 8% were dried to below 8%.

All seed lots were stored at MCs between 7 - 8%. Germination tests were done on winged and de-winged samples. Five samples of winged and partially de-winged seed were placed in vials. The winged seed were stored in 30 ml hinged-cap plastic vials and the de-winged seed in 2 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 seed. These vials were placed in Mason jars and stored at -20°C. The results after two years storage can be seen in Table 11.

Table11. Germination (%) of winged and de-winged white elm seed at time of storage and after two year storage at -20°C.

Seed lot	Winged		De-winged	
	Original Germ.	After 2 years	Original Germ.	After 2 years
20011008	92	92	98	97
20011010	97	86	94	96
20011012	88	81	96	98
20011013	86	86	98	93
20011014	92	96	97	98
Average	91	88	97	96

There was very little change in germination after two years storage for both seed treatments. Two of the winged seed lots (20011008 and 20011010) had seed that germinated normally except that the seed coat did not come off. These germinants were rated as low vigor. If these had been considered as high vigor there would have been no overall loss of germination after two years storage. Sufficient seed is stored to allow for several future evaluations, but based on these early results there does not appear to be any negative effects to removing the wing from white elm seed.

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. All six seed lots that were de-winged showed an improvement in germination. Average germination increased from 59.4 - 84.0% (Figure 18).

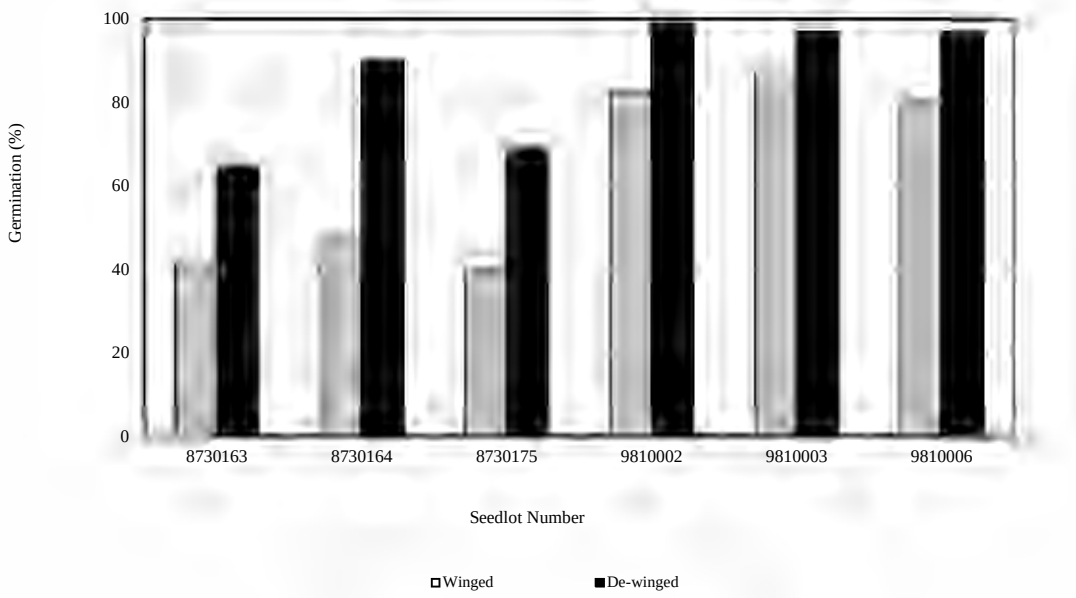

Figure 18. Comparison of germination of winged and de-winged seed lots of white elm.

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

COLLABORATION WITH COLLEAGUES

Larix lyallii X-ray Tests.

Donna Palamarek of the Alberta Tree Improvement & Seed Centre In Smoky Lake Alberta sent five samples of *Larix lyallii* seed for analysis.

The seed were X-rayed using Kodak Industrex Film and exposed for 15 seconds at 20 kV and 3 mA to determine the level of development of the embryos.

The overall results indicated that the embryos were not completely developed ranging from just starting to develop to about 75% developed. Details of the x-ray results for the five seed samples are given below.

4936 Moderate embryo development with development being quite consistent among the seed at about 30-40% of the lenght of the corrosion cavity.

4939 Little embryo development ranging from just starting to develop to about 30% of the lenght of the corrosion cavity.

4945 Similar to 4939

4946 Similar to 4939

4952 Moderate embryo development with most ranging between 30-75% but some at 10-15% of the length of the corrosion cavity.

The results indicate that the cones were collected too early even though collection was done at a time when the cone scales were beginning to separate.

PROMOTION OF 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 and meetings. The following highlights the activities of 2003.

Visitors to the Seed Centre in 2003 included: the Forest Nursery Practices (FOR 5912) class from the University of New Brunswick (UNB), the National Forest Genetic Resources Centre Advisory Committee, Joanna Baker (Internal Communications Advisor) and Cherie Traverse (Media Relations Officer) from The Source, the UNB freshman class (forestry), and delegation of managers and administrators from Shenyang, P. R. China.

The Seed Centre was again involved with National Forestry Week with a display at Science East in downtown Fredericton. The event was well attended and extremely well covered by media. A full-page write up with photos appeared in the Daily Gleaner which mentioned the National Tree Seed Centre. Two colour pictures referring to the Seed Centre were published in: Farr, K. 2003. The Forests of Canada. Fitzheny & Whiteside Limited. 152 p.

In 2001 the NTSC became part of the Atlantic Forestry Centre's web site. In addition to providing information about the National Tree Seed Centre, the site also provides information on seed collection, seed processing, seed storage, and gives a brief overview of annual activities. One of the main purposes is to provide clients with on-line information about the seed that is available for research. The web site continues to be very popular and is generating new clients.

The web site can be accessed by visiting the AFC web site home page or directly at http://www.atl.cfs.nrcan.gc.ca/SEEDCENTRE/SEED-CENTER-E.HTM. In 2003 the AFC web site received 3 471 839 hits. A hit is defined as a visit to a page of the web site and a hit on any given page can only occur every 7 days regardless of how many times the site is visited during that 7-day period by a single user. Information acquired from our web site manager, George Fanjoy, shows that the NTSC pages are consistently at or near the top with the most hits. In 2003, the NTSC received over 700 000 hits which represents over 20% of all hits to the AFC site.

SEED CENTRE STAFF

Staff at the NTSC consists of one full-time seed technologist (Bernard Daigle). The Seed Centre is managed by the National Forest Genetics Resource Manager, Dale Simpson.

In past years, the Seed Centre had sufficient budget allocation to hire a student during the summer. The budget in 2003-04 was insufficient to hire a summer student. Also, in past years, extra help was often provided through employees being assigned to the Seed Centre for a period of time. The only extra help of this nature in 2003 was Peter Moreland who worked 3 days/week from January 6 to February 21, 2003.

The amount of "extra" help has been steadily declining. This is mainly due to decreased budget but is also the result of a lack or decrease in federal sponsored employment programs. The decrease in the number of germination tests is one of the consequences of this. Figure 20 illustrates the number of "extra" work weeks that were supplied to the Seed Centre on an annual basis over a 6 year period.

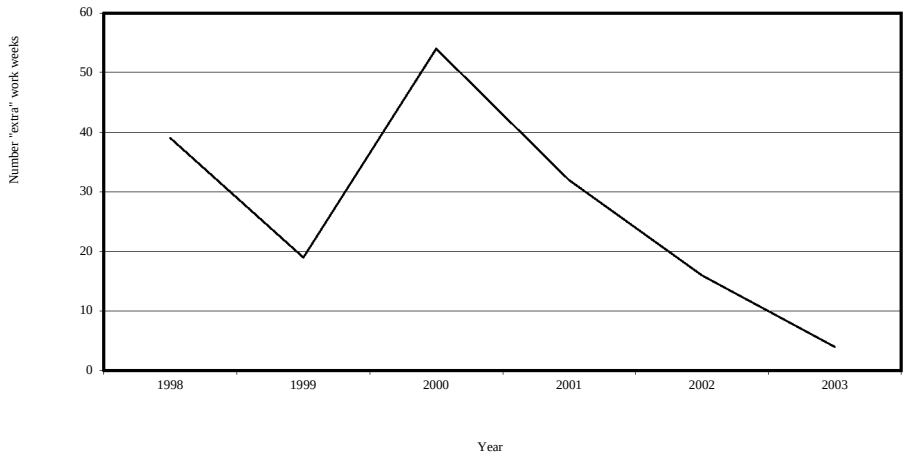

Figure 20. Number of "extra" work weeks provided to NTSC between 1998-2003.

Sugar Maple Germination Experiment

Schedule of Events

Mar 31	Begin 14 day soak of all seed lots Set up germination test of 2 controls (20 tests)
Apr 1	24 hr soak MC (10 MCs)
Apr 2	48 hr soak MC (10 MCs)
Apr 3	72 hr soak MC (10 MCs)
Apr 7	7 day soak MC (10 MCs)
Apr 11	Begin 3 day soak of all seed lots Set up germination boxes (180 boxes)
Apr 14	14 day soak MC (10 MCs) Set up germination test of all seed lots (180 tests)
June 16	All seed chilled for 8 weeks in germinator (60 tests) MC of seed chilled for 8 weeks (30 MCs)
July 14	All seed chilled for 12 weeks in germinator (60 tests) MC of seed chilled for 12 weeks (30 MCs)
Aug 11	All seed chilled for 16 weeks in germinator (60 tests) MC of seed chilled for 8 weeks (30 Mcs)

Suggestions for 2003 report

Include seed requests to 1967
“Beef up” collaboration / linkages with colleagues, organizations, expert advice
- Carlos Ramirez, Donnie Mcphee (beech grafting, bur oak seed storage, etc.),

Use comments to help explain how tends are changing (# seed requests, # experiments, etc..)

Numbering system for experiments

1998-01	Willow Storage Experiment (1998)
1999-01	Red Oak Storage Experiment I
1999-02	Willow Storage Experiment (1999)
1999-03	Sugar maple Germination Experiment
1999-04	White Spruce Germination Experiment
1999-05	Northern red Ash Germination Experiment
1999-06	Bur Oak Storage Experiment
2000-01	Red Oak Storage Experiment II
2000-02	Seed Germination Curves
2000-03	Seed Imbibition Trial
2000-04	White Ash Germination Experiment
2000-05	Beech Germination Experiment
2000-06	White Spruce Moist Chilling Experiment
2000-07	De-winging of Birch Seed
2000-08	Striped Maple Germination Experiment
2001-01	White Pine Seed Storage Experiment
2001-02	Ironwood Germination Results
2001-03	White Elm De-winging
2001-04	White Elm Storage Experiment
2001-05	De-winging of Old White Elm Seedlots
2001-06	De-winging of Old White Birch Seedlots
2001-07	Alcohol Separation of White Birch Seedlots
2002-01	Conditioning of Seed
2002-02	Evaluation of Moisture Content of White Spruce Seedlots
2002-03	Effect of Seed Head on Moisture Content of Seed
2002-04	Alder De-winging and alcohol separation
2002-05	Sugar Maple Germination Experiment
2002-06	Mountain Maple Germination Experiment
2002-07	Silver Maple Storage Experiment
2002.08	Sugar maple Collection Experiment
2002-09	Eastern Hemlock Germination Experiment
2002-10	Alcohol Tolerance Test – Eastern Hemlock