# Activities Related to Poplar and Willow Cultivation and Utilization in Canada

Canadian Report to the 23rd Session of
the International Poplar Commission
Beijing, China
Period 2004–2007

October 2008

Updated 8 December 2008

Poplar Council of Canada
Conseil du Peuplier du Canada

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Prepared for:

Poplar Council of Canada/Conseil du Peuplier du Canada

Prepared by:

Cees ("*Case*") van Oosten, M.Sc.F., R.P.F.
SilviConsult Woody Crops Technology Inc.
2356 York Crescent
Nanaimo, British Columbia
Canada V9T 4N3

Phone: (00)1 250 758 8230
Fax: (00)1 250 758 8251
Email: silviconsult@telus.net

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| Organization | Location |
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| ▪ Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration - Shelterbelt Centre | Saskatchewan |
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| ▪ Alberta-Pacific Forest Industries Inc. | Alberta |
| ▪ Canadian Wood Fibre Centre - Canadian Forest Service | Alberta |
| ▪ Charles Provost et associés | Quebec |
| ▪ Daishowa-Marubeni International Ltd. | Alberta |
| ▪ Domtar Inc.(Windsor) | Quebec |
| ▪ Eastern Ontario Model Forest | Ontario |
| ▪ ForestFirst (used to be Saskatchewan Forest Centre) | Saskatchewan |
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| ▪ Norampac Cascades Canada Inc. | Quebec |
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| ▪ Université-du-Québec-en-Abitibi-Témiscamingue | Quebec |
| ▪ University of Alberta | Alberta |
| ▪ University of Alberta & Alberta-Pacific Forest Industries Inc. | Alberta |
| ▪ University of British Columbia | British Columbia |
| ▪ University of Toronto | Ontario |

The list of persons contacted for the preparation of this report can be located in Appendix IX. Their support and assistance are gratefully acknowledged.

# TABLE OF CONTENTS (TOC)

**Note**: Appendix X contains a listing of publications published in Canada and/or authored by persons residing in Canada. This Appendix will be made available under separate cover or on the Poplar Council of Canada Website (www.poplar.ca.).

# 1 FOREWORD

The 2008 Report covers the period from 2004 to 2007 (incl.). The information collected in this report summarizes the activities during this period and any changes from the previous 2004 report[1]. Some of the content completed for the 2004 report 'Activities Related to Poplar and Willow Cultivation and Utilization in Canada' in the sections dealing with 'Policy and Legislation' and 'Statistics (Forest Inventories – Canada)' remains unchanged, except for minor updates, changes (e.g. Website references, name changes of Government Ministries etc.), deletions and additions. Where major changes were needed, the original text has been altered, deleted or new text has been inserted to reflect these changes. Canada's Forest Inventory 2001 (CanFI2001) was last updated in 2001 and formed the basis for both the 2004 and this 2008 Canadian Report to the International Poplar Commission for the periods 2001-2003 and 2004-2007 respectively.

I want to thank John Doornbos and Jim Richardson of the Poplar Council of Canada for their guidance, advice and their time to review the draft of this report.

## *1.1 UPDATES 8 DECEMBER 2008*

Updates made 8 December 2008 can be located in Appendix XI.

# 2 INTRODUCTION

The words *Populus* (in this report *Populus* refers to the genus and not section, unless specifically mentioned), poplar or aspen can be used interchangeably in this report; however, where appropriate this report distinguishes between:

**Aspen** species, such as *Populus tremuloides*, *P. grandidentata* and *P. tremula* (not native to North America) in the *Populus* section, formerly *Leuce* (Aspens and white poplars). *Populus tremuloides* is commonly known as trembling or quaking aspen, or just aspen and is by far the dominant *Populus* species in Canada. It occurs mainly in the boreal region of Canada. Hybrid aspen thus refers to the artificial interspecific hybrids of *P. tremuloides* and *P. tremula* (including the variety *davidiana* or Chinese or Korean poplar).

**Poplar** (non-aspen) species, such as *P. balsamifera*, *P. trichocarpa* (both native to North America), *P. maximowiczii*[2]) and *P. laurifolia* in the *Tacamahaca* section (Balsam poplars), and *P. deltoides* (native to North America) and *P. nigra* in the *Aigeiros* section (Cottonwoods and black poplar). Hybrid poplar thus refers to the natural or artificial interspecific and/or intersectional hybrids. *P. deltoides* and *P. trichocarpa* are frequently referred to as eastern cottonwood and black cottonwood respectively, or just cottonwoods and *P. balsamifera* is known as balsam poplar.

[1] Canadian Report to the 22nd Session, Santiago, Chile - International Poplar Commission for the Period 2000-2003.

[2] *Populus maximowiczii* is also colloquially referred to as 'Max'.

There is an increasing interest in Canada in the use of willow (*Salix* spp.) for both environmental and biomass crop applications. Canadian research and development work with *Salix* is ongoing in the Prairie Region, Quebec and New Brunswick. The names *Salix* and willow are used interchangeably in this report.

The main regions with economically significant *Populus* stands are located from the Province of British Columbia to the Province of Quebec (see map on page - 3 -). In the four Atlantic Provinces east of Quebec (Newfoundland & Labrador, Nova Scotia, Prince Edward Island and New Brunswick) natural *Populus* stands are less common and less economically important than in the remaining provinces of Canada and form only a minor source of industrial wood. Inventory data for these four provinces have been included in this report's Appendices (I, II, III, IV-Chart 1), but no further mention of these provinces is made in the report. This is also the case for Nunavut, the Yukon and Northwest Territories in northern Canada.

The aspen resource has become increasingly valuable as a source of fibre for the pulp and paper industry and for the composite wood industry, primarily Oriented Strand Board (OSB).

This report frequently refers to short-rotation-intensive-culture or SRIC (hybrid) poplar and willow crops. These SRIC woody crops are established and managed using an agronomic approach to crop management on cleared (usually) agricultural land, requiring a short rotation (usually less than 25 years for poplar and 5 to 6 years for willow). SRIC woody crops could be compared to the 'trees-outside-forests' or TOF, a term used by the International Poplar Commission.

For the readers not familiar with the term 'Crown' land: Crown land is owned and managed by the respective provinces or, in some cases, by the federal government. Any references to Crown and/or public land in this report are to Provincial Crown land.

There is frequent reference to the Prairie Provinces, which include Alberta, Saskatchewan and Manitoba. The Prairie region refers to these three provinces, as well as the northeast corner of British Columbia, located to the east of the Rocky Mountains.

A glossary of terms can be found in Appendix VIII.

At the request of the International Poplar Commission (IPC), an extensive listing of publications by authors residing in Canada and/or publications published in Canada complements this report; it includes refereed papers as well as theses, technical reports and conference proceedings.

The use of the word 'crop(s)' refers to short-rotation-intensive-culture (SRIC) crops of (hybrid) poplar (or aspen) and/or (hybrid) willow. The words 'plantation' or 'forest plantation(s)' refer to plantations on forestland.


Map: Courtesy Natural Resources Canada

# 3 SUMMARY

Provincial policies and legislation on property valuation and taxation for land growing a tree crop vary widely across Canada. Only the Province of British Columbia recognizes intensively-managed *Populus* and *Salix* plantations, which are SRIC crops, as primary agricultural production, but imposes a maximum rotation length of 12 years. The Province of Saskatchewan offers the most favourable property valuation and taxation rate that applies to rural, mostly agricultural land, regardless of what crop is grown; this includes tree or woody crops.

The vast majority of the *Populus* inventory in Canada consists of natural stands. The estimated poplar and aspen inventory is 4.0 billion $m^3$ on 161.5 million hectares (Appendix III), of which approximately 3.5 billion $m^3$ on 28.1 million hectares (Appendices I and II) consist of stands where the genus *Populus* is the predominant genus. The provincial *Populus* age class distributions in stands with *Populus* as the predominant genus show serious imbalances, with a general shortage of 'replacement stock' in the 0-20 and 21-40 year age classes. Currently the (estimated) annual *Populus* harvest levels are below the allowable annual cut (AAC) levels. *Salix* is not recognized as a commercial species in Canada's inventories; however, *Salix* species do show up in Canada's Forest Inventory (CanFi).

There is no national system that regulates the identification, registration and control of *Populus* or *Salix* clones. Two provinces have regulations regarding the deployment of genetically improved forest trees, including hybrid *Populus* clones on Crown (public) land. Almost 15 years ago the Poplar Council of Canada (PCC) tried to introduce a voluntary Certification Service for *Populus* clones, but that initiative did not succeed, due to lack of support from industry.

Selection and breeding of *Populus* clones differ regionally. The Province of Quebec has a selection and breeding program serving provincial needs only on both public and private forestland. One Federal Government of Canada department in Saskatchewan is also involved in selection and breeding of *Populus* clones, but its mandate is primarily aimed at environmental uses, including use in farm shelterbelts and restoration of riparian areas in Canada's Prairie region. This department has been collaborating with an Alberta industrial SRIC hybrid poplar crop owner in a cost-sharing arrangement to select and breed new clones suitable for SRIC woody crop use; that collaboration continues to date. One company in British Columbia completed a modest breeding effort and is still in the process of clonal selection. An Alberta industrial organization is actively involved in the selection and breeding of (hybrid) aspen clones for future deployment in forest plantations and SRIC crops. There is no national strategy for the selection and breeding of new *Populus* clones.

Currently there is no breeding program for *Salix* either; however, a Federal Government of Canada department in Saskatchewan is involved in selection and eventual breeding of *Salix* clones; again its mandate is primarily aimed at environmental uses, such as riparian

restoration and phytoremediation. Several private individuals, non-Government organizations and Federal Government organizations are involved in trials with *Salix* clones to determine their value in biomass production and phytoremediation, especially in solving municipal effluent problems. As with poplar, there is no national strategy for the selection and breeding of new *Salix* clones.

For the period 2004-2007, planting of forest plantations in Canada totalled 4,729 hectares, slightly less than the 4,935 hectares reported for the period 2000-2003. It is highly unlikely that this difference is the result of harvesting, as these plantations are still quite young[1]. All plantations of poplar are located on forestland and total approximately 11,420 hectares (Table 4). Mean annual increments (MAI[2]) range from 12 to 20 $m^3$ $ha^{-1}$ $yr^{-1}$ on 20 to 33 year rotations (Table 5). Besides basic site preparation (usually a spot site preparation) and initial weed control, no further management is carried out, except for possibly pruning. Stand densities vary widely from 280 to 1,111 stems per hectare, depending on the owner's objectives and cost allowances for treatments.

Short-rotation-intensive-culture (SRIC) hybrid poplar crops planted in the period 2004-2007 increased in area to 5,425 hectares from 5,167 hectares reported for the period 2000-2003 (Table 6). These crops are located on agricultural land that was previously in use for more traditional agricultural production. The SRIC hybrid poplar crops are managed using agronomic methods. Mean annual increments (MAI) range from 16 to 25 $m^3$ $ha^{-1}$ $yr^{-1}$, on 15 to 18 year rotations (Table 7). Crop (stand) densities vary from 550 to 1,111 stems per hectare. These crops produce mostly pulpwood for the pulp and paper industry; however, several recent crops were established to produce wood for the panel board industry (OSB).

Only a small amount of experimental planting takes place with aspen species; most of the work with aspen is still in the development stage and mass propagation of desirable (hybrid) aspen clones for operational deployment is still very challenging.

The small amount of willow crops planted for biomass or phytoremediation reasons is still experimental. These crop types are expected to increase in size and importance over the next five to 10 years.

There were two significant developments in poplar diseases in Quebec. The province reported the first-ever recorded occurrence of the rust *Melampsora larici-populina* in a nursery. This disease has now spread beyond that nursery into several hybrid poplar forest plantations[3]. *Septoria musiva* stem canker disease continues to spread into new areas. With the recent increases in SRIC hybrid poplar crops in the Prairie region, the disease *Septoria musiva* has noticeably increased its presence there as well; many of the hybrid poplar clones in use appear to be susceptible to this disease, which causes stem cankers. In southwestern British Columbia this serious disease was located and

[1] The net loss of plantation area is mostly the result of inconsistencies in reporting of hectares by plantation owners in 2004 cf. 2007.
[2] Mean annual increment or MAI is expressed in $m^3$ per hectare per year, or $m^3$ $ha^{-1}$ $yr^{-1}$.
[3] Pierre Périnet – personal communication.

subsequently positively identified for the first time in 2006; it is the only recorded incidence of this disease west of the Rocky Mountains anywhere in North America.

One company that manages a large-scale SRIC hybrid poplar crop in Alberta sold its 'verified GHG (greenhouse gas) emission reductions' from SRIC hybrid poplar crops, established between 2004 and 2007, to Environment Canada[1].

[1] Ken Plourde – personal communication

# 4 POLICY AND LEGISLATION

Provinces in Canada have full jurisdiction over forest management and agriculture regulations, thus taxation on property and various forest and agriculture regulations are strictly a provincial affair. Federal income tax rules apply nationwide and are administered by the Canada Revenue Agency (CRA). The federal income tax rules will not be discussed in this report, as there are no specific policies or federal tax incentives pertaining to *Populus* or *Salix*.

Two provinces, British Columbia and Alberta, have regulations that govern the deployment of (hybrid) clonal material and/or genetically improved material on Crown lands.

The only province with a specific property tax policy and supporting regulations pertaining to *Populus* and *Salix* management is British Columbia (BC), where intensively-managed *Populus*[1] or *Salix* crops can be recognized as primary agricultural production. The British Columbia incentives and regulations apply to private land. Besides the policy for intensively-managed *Populus* and *Salix* on private land, British Columbia also has property tax regulations that can apply to privately-held managed forests and/or woodlots, as do Ontario and Quebec. The three Prairie Provinces (Alberta, Saskatchewan and Manitoba – see map page - 3 -) do not have specific tax policies for privately-held managed forestland or woodlots. The report will review the various policies and property tax arrangements for each of the provinces west of the Atlantic Provinces.

Property tax law and regulations generally do not apply to Crown land, except in British Columbia for Crown lands leased for the purpose of farming or grazing, which theoretically could include poplar farming.

## *4.1 BRITISH COLUMBIA*

### 4.1.1 POPULUS AND SALIX AS PRIMARY AGRICULTURAL PRODUCTION

Since 1995 the British Columbia Assessment Act's Standards for the Classification of Land as a Farm Regulation[2] recognize "*Populus species and Salix species intensively cultivated in plantations* (crops)" as primary agricultural production. Land that is privately owned or leased and is growing *Populus* or *Salix* species can be classified as a developing farm when:

"*in the case of products produced from primary agricultural production that require 7 to 12 years to establish after planting, there is a sufficient area prepared and planted to*

[1] This includes SRIC aspen crops.

[2] http://bcassessment.gov.bc.ca/process/agricultural_forestry/classify_farm.asp &/or http://bcassessment.gov.bc.ca/pdf/process/agri_forest/farm_brochure.pdf

*meet the requirements of this regulation when harvesting occurs and the assessor determines that there is a reasonable expectation of profit from farming*."

The latter criterion of "*a reasonable expectation of profit from farming*" is similar to that used by the Canada Revenue Agency to allow certain deductions for farm expenses.

The regulations cover a variety of products and uses and are aimed at providing tax incentives for legitimate farming operations. The landowner or lessee must submit, with his application, a development plan and a map outlining crop details, area to be planted, date of planting, expected yields, anticipated selling prices and a date of harvest.

*Populus* and *Salix* species managed beyond the 12-year window do not technically qualify as primary agricultural production and neither do plantations not intensively managed, nor do natural stands.

Through an Order-in-Council, the Assessment Commissioner, who is the Chief Executive Officer of the British Columbia Assessment Authority, sets the valuation rates for farm use. These rates reflect the land capability and land use. The assessed value of farmland is usually lower than market value, especially in the more populated areas of the province, where market values are driven up by non-farm market pressures on the land base. In some rural areas farm valuation rates are similar to assessed market values.

The tax rate for farmland is in a separate rate class. The farm rates are usually one of the lowest tax rates. Besides a lower valuation and tax rate, there are several important exemptions from taxation of the school and hospital tax. An additional advantage for legitimate poplar or willow farms is the eligibility for an exemption from provincial sales tax.

Although the regulations are beneficial to poplar and willow planting, the restriction of the rotation to 12 years has now proven problematic for poplar plantations. Yield plots in southwestern British Columbia[1] show that SRIC hybrid poplar crops planted at 1,100 or fewer stems per hectare do not culminate mean annual increment (MAI) within the 12-year period, especially when grown to produce saw logs or veneer logs at a reduced crop density. For the independent crop owner this may jeopardize the "*reasonable expectation of profit from farming*", which is a key provision in both the Federal Income Tax regulations and the provincial farm assessment regulations. To change the restrictive rotation length to a more appropriate length can only be affected through a political process; there is currently no regulatory mechanism to allow for a change.

A major advantage of classifying *Populus* and *Salix* species as primary agricultural production has been the flexibility of managing the crop without the regulations that apply to a more traditional forest crop. As a farming operation, there is also the added protection through the Farm Practices Protection (Right to Farm) Act in British Columbia[2]. Under this act 'farm operation' means any of the following activities involved in carrying on a farm business:

[1] Personal information.
[2] http://www.qp.gov.bc.ca/statreg/stat/F/96131_01.htm

a) Growing, producing, raising or keeping animals or plants, including mushrooms, or the primary products of those plants or animals;
b) Clearing, draining, irrigating or cultivating land;
c) Using farm machinery, equipment, devices, materials and structures;
d) Applying fertilizers, manure, pesticides and biological control agents, including by ground and aerial spraying; and
e) Conducting any other agricultural activity on, in or over agricultural land, including *"intensively cultivating in plantations, any (i) specialty wood crops, or (ii) specialty fibre crops"*.

This protection does not apply to forests in the Managed Forestland class.

There is one regulation applying to more traditional forest crops that also applies to SRIC woody crops grown on private farmland. All 'timber' produced in British Columbia must be scaled and measured under the provisions of the Forest and Range Practices Act ('Timber' includes logs and chips), regardless of its origin (Crown or. private land). Owners of SRIC hybrid poplar and willow crops grown on farmland must obtain a 'Timbermark' and must make provisions to have their harvest scaled by a licensed scaler[1]. What is unclear at this point is how biomass crops on very short coppice rotations will be handled under the Forest and Range Practices Act.

### 4.1.2 MANAGED FORESTLAND

Managed Forestland[2] (MFL) is privately-owned forestland subject to an acceptable and approved forest management commitment that complies with the Private Managed Forestland Act. Property owners in this class are obliged to provide good resource management practices, such as reforestation, stand tending, protection from fire and disease and sound harvesting methods. The assessed forestland value is based on its capability for tree growth and therefore recognizes the land for its forest use value. The assessed value is not subject to other market forces, such as its true market value for possible other uses. The valuation is a two-step process:

1. The British Columbia Assessment Authority determines the value of the land without trees, including other factors, such as growth capability, location, topography and accessibility. The assessor applies a schedule of regulated values to the bare land. At this stage trees are not assessed a value;
2. After the trees are harvested, BC Assessment will add the assessed value of the harvested trees to the bare land value of the land.

Poplar or willow crops not recognized as primary agricultural production, i.e. stands that exceed the 12-year rotation or stands that are not intensively-managed as a farm crop, can still qualify under the Managed Forestland class. Natural poplar stands could also qualify, provided they meet the above-mentioned conditions. There are size restrictions and to be classified as MFL, "*the land must be at least 25 hectares and be managed as a*

[1] Bruce Walders – personal communication.
[2] http://bcassessment.gov.bc.ca/process/agricultural_forestry/managed_forest.asp.

*single unit, or, if the land is 50 hectares or less, at least 70% of the land must be productive during the year ending on October 31. If the land measures more than 50 hectares, at least 50% of the land must be productive during the year ending on October 31".*

Forestland classed as MFL offers several benefits:

a) Owners are assured the right to harvest trees;
b) Assessments are reasonably stable through years of no harvesting;
c) Increased assessments will apply only following a year in which tree harvesting occurs.

## *4.2 ALBERTA*

There are no specific policies or tax measures promoting the management of *Populus* or *Salix* species in Alberta.

Rural land is generally valued as either agricultural, based on productive capability rather than market value, or as non-agricultural land, valued at market value. Private-held forestland and woodlots are not considered agriculture and are generally assessed at market value, rather than productive capability. Property value assessment of forestland and woodlots at market value frequently leads to accelerated liquidation of the standing timber inventories in order to reduce the property tax burden.

Much of the private wood purchased by various companies thus comes from forests that are being liquidated for agricultural or other industrial development. This liquidation process reduces the opportunity to obtain fibre from these sources in the future. With projected increases in mill production and forecast reductions in land committed to sustainable fibre production, the hardwood[1], i.e. aspen and poplar, fibre shortage is expected to increase. There are opportunities to retain and manage private forestlands and woodlots for sustainable fibre production by offering incentives to landowners through a more appropriate valuation and tax process. This will encourage sustainable management, rather than liquidation, of forested private land, and also afforestation of cleared farmland. This latter category is of increasing importance to several land owners and corporations, who are planning to establish or are currently establishing aspen and poplar plantations.

The Province of Alberta is divided into two main administrative areas, the White Area and the Green Area. Both areas are managed in a multiple use context; however, there is an important difference between the two areas:

a) The White Area is generally settled or suitable for settlement and it is usually associated with more intensive uses such as agriculture, urban centres and well-developed infrastructure;

[1] The term hardwood is used throughout this report and refers to the deciduous or broadleaved species present in the inventory; it does **not** include deciduous species such as *Larix*. The terms hardwood and deciduous are used interchangeably.

b) The Green Area, which is largely permanent forest; it is mostly associated with less intensive uses such as timber harvesting (logging), wild land recreation and grazing.

Much of the privately-held forestlands, woodlots and agricultural lands suitable for afforestation to aspen and poplar are located in the White Area, where several land owners and corporations are planning to establish or are currently establishing SRIC aspen and poplar crops. Alberta-Pacific Forest Industries Inc. (Al-Pac) is the only corporation in Alberta currently engaged in establishing and managing large-scale operational SRIC hybrid poplar crops on farmland. Ainsworth Engineered Canada LP has also started to establish SRIC hybrid poplar crops to provide a sustainable supply of wood for its OSB plant in Grande Prairie (Alberta).

Several years ago Alberta was contemplating changing its property tax laws to recognize managed private woodlots, which would have had a positive impact on sustainable management of aspen and poplar. These proposals were part of an omnibus of legislative changes pertaining to agricultural assessment regulations, including regulations for intensive livestock operations. The unfortunate occurrence of a single cow with bovine spongiform encephalopathy (BSE) changed all that, cancelling all of these legislative initiatives[1]. Changes to Alberta's property tax laws have yet to take place[2].

Land ownership rules in Alberta put restrictions on foreign-owned corporations leasing or owning land. A foreign-owned corporation can only lease less than 5 acres (2 hectares) for a period not exceeding 20 years. A 2004 Order-in-Council allowed Alberta-Pacific Forest Industries Inc. (Al-Pac) to lease 25,000 hectares for up to 30 years, provided the land classification did not exceed a certain value, restricting such leases to lower farmland classes. In the fall of 2007 the Government dropped the restriction in land classification, thereby allowing Al-Pac to lease any and all classes of land[3]. The Order-in-Council and the 2007 ruling only apply to Alberta-Pacific Forest Industries Inc.; however, it sets a precedent for other foreign-owned corporations, should they be interested in leasing land for the purpose of growing an SRIC woody crop.

## *4.3 SASKATCHEWAN*

As in Alberta, there are no specific policies or tax measures promoting the management of *Populus* or *Salix* species in Saskatchewan.

For woodlots or other privately-held forestland there are no incentives for properties classified as "*forest property*" or managed as woodlots or tree plantations[4]. The Saskatchewan Assessment Management Agency (SAMA) assesses woodlots using agricultural land valuation. Rural land is assumed to be for an agricultural purpose, capable of agricultural crop production and proper tillage, and is assessed as such.

[1] Byron Grundberg, Larry Collins – personal communication – 2004.
[2] Al Bertschi – personal communication.
[3] Randy McNamara – personal communication.
[4] Gary Coghill - Saskatchewan Agriculture, Food and Rural Revitalization: 'Income tax and property tax implications for woodlots and tree plantations' - undated

Arable (cultivatable) land is assessed at 55% and non-arable (non-cultivatable) land at 50% of the assessed value, resulting in rural forestlands being in one of the lowest property tax classes. A recent change lowered the assessment rate for land growing grain that is converted to treed land (including SRIC woody crops) from 55% to 50%; the same applies to grain land converted to grassland. The actual tax savings are insignificant[1]. A 2004 study in Saskatchewan concludes that "*results of the economic analysis in this study suggest that the actual impediment to afforestation and agroforestry arising from the cost of property taxation to the producer is very small relative to other economic disincentives that include high establishment costs and the substantial time lag until harvest. Property assessment for taxation purposes generally rates agricultural land at the lowest valuation rates*". The same study recommends "*If property taxation incentives are to be applied, they should encourage producers to incorporate good management practices in their afforestation or agroforestry operations. Such practices develop long-term, sustainable industry and have demonstrable environmental benefit. Accordingly, we can conclude that a move towards a vigorous Management Plan regime for private land forestation in conjunction with target-specific property taxation adjustments that direct incentives to producers will lead to better profitability and resource management than is presently the case*" [2].

To date there are no new developments on this issue.

ForestFirst (used to be Saskatchewan Forest Centre)[3] has been in discussions with Saskatchewan Crop Insurance Corporation, a Crown Corporation under the Minister of Agriculture, to determine the feasibility of crop insurance for SRIC hybrid poplar crops[4]. The concept is to

- provide crop insurance against uncontrollable losses during the establishment phase; and to
- provide crop insurance against yield losses.

This concept is still in the discussion stage and the latest report is that the entire crop insurance program is under review. ForestFirst has made recent submissions to the Saskatchewan Crop Insurance Corporation to recommend that SRIC woody crops be covered under the program[5]. If accepted, the insurance concept would be developed under the 'New Crops Program'[6].

[1] Douglas Currie – personal communication.
[2] Ken Belcher, Richard Edwards, Hayley Hesseln, Richard Marleau - Centre for Studies in Agriculture,Law and the Environment: 'Developing Saskatchewan Property Taxation Policies for Afforestation and Agroforestry Systems: A Legislative and Economic Overview' – 29 April 2004.
[3] http://www.forestfirst.ca.
[4] Larry White – personal communication - 2004.
[5] Larry White – personal communication.
[6] http://www.saskcropinsurance.com/programs.

## 4.4 MANITOBA

As in Alberta and Saskatchewan, Manitoba has no specific policies or tax measures promoting the management of *Populus* or *Salix* species. That situation has not changed since 2004[1].

Land taxes for forestland are lower than for agricultural land and there are no incentives available for management of woodlots[2].

## 4.5 ONTARIO

As in the Prairie Provinces, Ontario does not have specific policies or tax measures promoting the management of *Populus* or *Salix* species, but Ontario does offer a Managed Forest Tax Incentive Program to eligible forestland owners.

### 4.5.1 MANAGED FORESTLAND

"The Managed Forest Tax Incentive Program (MFTIP) is designed to encourage landowner participation in natural resource stewardship on private forest land in Ontario."[3] The Ontario Woodlot Association defines it as "*The goal of the MFTIP program is to bring greater fairness to the property tax system by valuing forestland according to its current use*."[4] The Managed Forest Tax Incentive Program (MFTIP) allows for a reduction in property taxes to forestland owners who prepare an approved management plan and commit to good stewardship of their property. Recently the term of the program was increased from five to 10 years on a renewable basis. A five-year progress report needs to be filed in order to continue qualification under the program. The MFTIP is meant to remove financial barriers to good management by valuing the land for its current use. Eligible land is taxed at 25 percent of the municipal tax rate set for residential properties.

In Ontario the Municipal Property Assessment Corporation (MPAC) is responsible to carry out property assessments, while the municipalities are responsible for the administration of the property tax system, including billing. Areas planted to and managed for *Populus* species are considered managed forests, provided there is an approved management plan; this applies to poplars planted on farmland (SRIC crops) and on forestland. It is unclear how this incentive program would affect SRIC willow crops.

Managed forest must meet several conditions:

a) The land owner must be a Canadian citizen, corporation, partnership or conservation authority;
b) The forest area must cover at least 4 hectares (10 acres) excluding all residences;
c) The forest must all be on one property with one municipal roll number;

[1] Shane Tornblom – personal communication.
[2] Patricia Pohrebniuk – personal communication - 2004)
[3] http://www.mnr.gov.on.ca/en/Business/Forests/Publication/MNR_E000245P.html.
[4] http://www.ont-woodlot-assoc.org/forman_mftip.html.

d) There must be a minimum number of trees on each hectare (acre), depending on size;
e) The land cannot be subject to a 'Registered Plan' of subdivision or be licensed under the Aggregate Resources Act (*note the recent change*[1]).

From a poplar-management perspective, the criterion of a minimum number of trees per hectare could cause some grief. The minimum number of stems per hectare (spha) is 1,000 at any time, but does decline as the diameter-at-breast-height (dbh) increases. A grower, who intends to establish e.g. 500 stems per hectare (spha) to manage the stand for the saw log or veneer log market, runs the risk of the plantation not meeting the eligibility criteria until the average dbh is in excess of 12 cm [2].

The new assessment method caused numerous complaints of property taxes actually increasing and led to calls for the assessed value to revert to the subset of farm values as used before. The complaints resulted in a formal review under the Environmental Bill of Rights (EBR) of the MFTIB system[3]. Changes were made as a result and "Managed Forest (MF) properties will be assessed in a manner similar to the method used for farmland, which is based on land productivity rates. Under the new assessment approach, it is estimated that more than 80% of the MFTIP properties will experience lower assessments when compared to the previous assessment procedure.[4]

## *4.6 QUEBEC*

The Province of Quebec does not have specific policies for the establishment and management of *Populus* or *Salix* species on either public or private land. Most poplar is planted on private and public forestland with only approximately 3-4% planted on cleared agricultural land[5]. Public lands are governed by the 1986 Forest Act («Loi sur les forêts»), which states that forests must be managed in a sustainable fashion and must meet several important criteria. Although the Forest Act is not very explicit about how the rules affect private forestland, management criteria also apply to private forests and woodlots. Woodlot owners can obtain financial and technical assistance from the government to develop their forests. There are 17 Regional Agencies («Agence régionale de mise en valeur des forêts privées») in Quebec to promote private forest management in accordance with the principles of sustainable development. These agencies are composed of representatives of the private forestland owners, forest companies (forest companies are official members of the Agency per se), local municipalities and the

[1] Effective January 1, 2007, the regulations of the Act state that if "*property is in a newly designated area under the Aggregate Resources Act or was previously zoned for extraction, but is not licensed (i.e., you are not extracting aggregate), your property may now be eligible for the program, subject to other program eligibility requirements*" – source: http://www.ont-woodlot-assoc.org/forman_mftip.html.
[2] The criteria are: 1,000 spha any size of tree; 750 spha with dbh > 5 cm; 500 spha with dbh > 12 cm; 250 spha with dbh > 20 cm.
[3] Ministry of Natural Resources and Ministry of Finance – Managed Forest Tax Incentive Program (MFTIB), June 2004 – file name: EBR Review R2003005.
[4] http://www.ont-woodlot-assoc.org/MFTIP_11_06.html.
[5] Pierre Gagné – personal communication.

Ministry of Natural Resources and Wildlife, «Ministère des Ressources naturelles et de la Faune» (MRNF)[1].

### 4.6.1 MANAGED FORESTLAND

Planning of forest management activities on private land is scrutinized by the Regional Agency and is subject to public consultation. Regional Agencies for private forestland (development) are responsible for forest protection planning and forest development planning that meet objectives of the Regional County Municipalities (RCM-s). Agencies submit their plans to the RCM in whose jurisdiction they operate in order to reach an agreement. The Regional Agencies have nothing to do with the management of public land. Planning of all forest management is subject to public consultation for both private and public forestlands[2].

Private forestland owners qualify for subsidies for site preparation, planting, tending and various silvicultural activities such as pruning, and these subsidies equally apply to forestland owners who plant and manage poplar; however, the number of treatments allowed for subsidies, the percentage paid by the landowner, the pruning height, etc. does vary from Agency to Agency[3]. The subsidies include free-of-charge planting stock, including hybrid poplar, supplied by the MRNF. One of the restrictive conditions of receiving these subsidies is that forestland owners cannot apply herbicides to control competing vegetation.

### 4.6.2 REAL ESTATE REFUND PROGRAM

Private forestland owners can also qualify for a reduction in land taxes under the Real Estate Refund Program. This includes private forestland owners who plant and manage poplar. Eligible owners can qualify for a tax credit equivalent to 85% of the amount of real estate tax (municipal and school taxes) payable on forestland. Forestland qualifies if registered by the certified forest producer who owns it. A "*Forest Producer's Certificate*" is issued by the MRNF[4].

### 4.6.3 FARMLAND FOR WOODY CROPS

Few poplar growers contemplate establishing SRIC poplar or willow crops on private farmland. One of the main reasons is that transfer of farmland to grow a woody crop, rather than a traditional agricultural crop, is regulated in Quebec and the practice is strongly discouraged on prime farmland. Agricultural land is protected for agricultural crops by law[5] and SRIC poplar or willow crops are not considered agriculture. There are ongoing discussions in Quebec that could lead to SRIC willow biomass crops being

[1] http://www.mrn.gouv.qc.ca/english/forest/quebec/quebec-system-management-act.jsp.
[2] Gisèle Bélanger – personal communication – 2004.
[3] Pierre Périnet – personal communication.
[4] http://www.mrn.gouv.qc.ca/english/forest/reimbursement/index.jsp.
[5] «*Loi sur la protection du territoire et des activités agricoles, ou zonage agricole*» (Gisèle Bélanger – personal communication - 2004).

considered an agricultural crop production system[1]. In December 2007 the «Union des producteurs agricoles» (UPA) adopted a resolution to be presented to the Department of Agriculture, Fisheries and Food, «Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec» (MAPAQ) to recognize willow biomass crops as agricultural production[2].

Before planting trees, landowners need to obtain authorization from MAPAQ to get an exemption from the act that regulates agriculture and agricultural zoning; this is negotiated at a regional level and both MRNF and MAPAQ are involved. Despite substantial interest from private land owners to plant hybrid poplar on farmland, obtaining authorization from MAPAQ to plant trees on agricultural land is very difficult[3].

[1] Michel Labrecque, Charles Provost – personal communication.
[2] Charles Provost – personal communication.
[3] Pierre Périnet – personal communication.

# 5 STATISTICS

## *5.1 FOREST INVENTORIES - CANADA*

In Canada, provinces have jurisdiction over forest resources and thus provincial agencies carry out and maintain forest inventory systems, which are continually updated and improved. Standards for data collection and compilation differ between provinces and are not necessarily compatible. Under the direction of the Canadian Council of Forest Ministers (CCFM)[1], the Canadian Forest Service (CFS) is charged with the compilation and maintenance of the database 'Canada's Forest Inventory (CanFI)' by collecting data from provincial, territorial and other forest management inventories. The information presented in this report results from the most recent compilation CanFI 2001, completed in 2006[2].

Approximately 20% of information originates from CanFI 1991 and "*because of the differences between CanFI 1991 and CanFI 2001 the inventories cannot be compared in any meaningful way*"[3].

Although willow is present in the inventory, it is not recognized as a predominant genus or leading species due to its low volume[4] at approximately 59,000 $m^3$. Predominant genus is defined as the most abundant tree genus in a stand; leading species is defined as the first species listed in forest stand descriptions[5]. CanFI 2001 does not distinguish between natural and planted poplars; natural stands of *Populus tremuloides* (trembling aspen) form the overwhelming majority of the inventory.

The inventory data used for this report are the same as reported in the 2004 Canadian Report to the 22nd Session, Santiago, Chile - International Poplar Commission for the Period 2000-2003. The recent 2006 recompilation resulted in only minor changes in inventory volumes and hectares, but did not warrant recompilation of the more detailed tables and appendices of the 2008 report.

Detailed inventory data are reported in Appendices I, II and III. The area data presented in Table 1 (and Appendix I) pertain to stands where the predominant genus is *Populus*; the corresponding volume data are presented in Table 1 (and Appendix II). Since the inventory is a combination of different sources and dates, the determination of the species predominance varies from crown closure to basal area to volume. Consequently, 28.3 million hectares of *Populus* include other species as does the corresponding volume of

[1] CCFM - Canadian Council of Forest Ministers – The CCFM is composed of the fourteen federal, provincial and territorial ministers responsible for forests supported by their Deputy Ministers - http://www.ccmf.org.
[2] Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Information Report BC-X-408 (7.6 MB); http://dsp-psd.pwgsc.gc.ca/collection_2007/nrcan-rncan/Fo143-2-408E.pdf.
[3] http://cfs.nrcan.gc.ca/subsite/canfi/index-canfi.
[4] Katja Power – personal communication.
[5] "Examination of area covered by the leading species grouped at the genus level yields results similar to the predominant genus area results". – Section 3.9, page 33 of publication Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Information Report BC-X-408.

3.5 billion $m^3$. The total volume of *Populus* species in Canada is estimated to be in excess of 4.0 billion $m^3$ on 161.5 million hectares (Appendix III) of stands where *Populus* species occur in the volume records. These data include hectares and volume of forest stands where the predominant genus is *Populus* (Table 1).

Table 1 - Hectares and volume $m^3$ of forest stands in Canada where the predominant*) genus is *Populus*

| Age class | Total Hectares (x 1,000) | Total Volume $m^3$ (x 1,000) |
|---|---|---|
| 0 - 20 | 1,317 | 17,645 |
| 21 - 40 | 4,272 | 218,348 |
| 41 - 60 | 6,109 | 673,136 |
| 61 - 80 | 6,141 | 1,004,769 |
| 81 - 100 | 3,945 | 721,550 |
| 101 - 120 | 2,285 | 440,589 |
| 121+ | 822 | 165,706 |
| Other**) | 3,395 | 275,109 |
| **Total** | **28,287** | **3,516,853** |

*) *Populus* predominant genus by crown closure, basal area or volume

**) Uneven-aged and unclassified

Source: Canada's Forest Inventory - CanFI 2001

Courtesy: Katja Power, Forest Inventory Officer - Canadian Forest Service

Based on data in Appendix III, the percentage of aspen is at least 84% in Quebec, 85% in Manitoba, 86% in Saskatchewan, 84% in Alberta and 83% in British Columbia in stands where *Populus* species occur in the volume records. These percentages do not include the aspen component in the Appendix III category "*Various Populus spp*." Therefore it would be reasonable to assume that the percentage of trembling aspen is at 85% of the total poplar inventory of 4.0 billion $m^3$. Data for Ontario do not distinguish between the different *Populus* species, but if 85% of the volume can reasonably be attributed to trembling aspen, Ontario's volume of trembling aspen would be close to 1.2 billion $m^3$. It could be concluded that the total estimated trembling aspen inventory is at least 3.4 billion $m^3$ (85% of 4.0 billion $m^3$) in stands with a *Populus* component.

The age class distribution for Canada (Table 1) is heavily weighted towards the 41-60 and 61-80 year age classes and represents about 43% of the total hectares. Over 20% is in older age classes, where trembling aspen may be at an increased risk of defect. The age class 21-40 years represents 15% of this inventory and the 0-20 year age class represents only a low 5% (Appendix IV – Chart 1). Nationally there is a serious age class imbalance, particularly in the youngest age class. Reasons for this imbalance include effective forest fire suppression and the (past) emphasis on establishing

coniferous stands. Forest fire acts as a "renewal agent' for the maintenance and dominance of natural aspen stands in an early seral[1] stage.

The age class imbalance is not consistent across the five dominant provinces (Appendix IV – Charts 2 & 3), but does indicate serious shortfalls in the so-called younger 'replacement' age classes.

- British Columbia has a fairly even age class distribution from the 41-60 year to the 101-120 year age class, but seriously lacks replacement hectares in the 21-40 and especially the 0-20 age class.
- Alberta shows a strongly skewed age class distribution with a heavy concentration in the 21-40 and 41-60 year age classes, but also shows a serious shortage in the 0-20 year age class.
- Saskatchewan shows a serious shortage in the 0-20 and 21-40 year age classes, but also has a significant area (21%) in 'Other' (unclassified and un-even aged).
- Manitoba has over 2.5 million hectares as unclassified and uneven-aged, which is more than 80% of the total hectares in the inventory. There is no reason to assume that the Manitoba situation is any different from that in Saskatchewan. The Manitoba information was not included in Charts 2 or 3 of Appendix IV.
- Ontario shows what resembles a 'normal' distribution of age classes, peaking in the 61-80 year age class with an imbalance in replacement hectares. There is a very serious shortage in the 0-20 and 21-40 year age classes.
- Quebec's situation is similar to Ontario's, but is peaking in the 41-60 year age class; there are few replacement hectares in the youngest age classes.

## 5.2 *IMPORT AND EXPORT OF LOGS & WOOD, LUMBER AND PLANTING STOCK*

All import and export statistics were obtained through Statistics Canada[2]. Statistics for wood and planting stock imports and exports are reported for the period 2004 through 2007.

### 5.2.1 LOGS & WOOD

The international import and export statistics for the period 2004 through 2007 for all of Canada showed a net influx of poplar, aspen and cottonwood saw logs, veneer logs and pulpwood (Table 2); this was also the case in the period 200-2003. The reasons for this net import are not documented; however, industrial consumption of roundwood in Quebec exceeded the harvest levels of *Populus* species and the shortfall was imported from Ontario and the US (see 5.3.6).

[1] A seral stage is an intermediate stage ecological succession leading towards a climax community.
[2] Statistics Canada database information on a fee-for-service basis: http://www.statcan.ca/trade/scripts/trade_search.cgi - search criterion "poplar" for the years 2004-2007.

Table 2 - Import & export summary - *Populus* species

| | m$^3$ | | | |
|---|---|---|---|---|
| **Import** | 2004 | 2005 | 2006 | 2007 |
| Poplar, aspen & cottonwood "in the rough" (non- | 43,451 | 46,535 | 29,911 | 44,026 |
| Poplar, aspen & cottonwood - Pulpwood | 48,405 | 48,296 | 57,481 | 69,576 |
| **Total** | **91,856** | **94,831** | **87,392** | **113,602** |
| | | | | |
| **Export** | | | | |
| Poplar, aspen & cottonwood saw logs & veneer logs | 38,802 | 25,821 | 32,099 | 7,471 |
| Poplar, aspen & cottonwood - Pulpwood | 1,275 | 17,996 | 8,693 | 4,044 |
| **Total** | **40,077** | **43,817** | **40,792** | **11,515** |
| | | | | |
| **Net Import** poplar, aspen & cottonwood | **51,779** | **51,014** | **46,600** | **102,087** |

* Note: "in the rough" means a cant or partially trimmed log

As expected, there are no statistics for willow.

### 5.2.2 LUMBER

During 2003 Canada exported 559,174 m$^3$ of poplar, aspen & cottonwood lumber (>6mm) and imported 150,466 m$^3$; Canada was a net exporter of poplar, aspen & cottonwood lumber in 2003 (Table 3).

Table 3 - Lumber import & export summary - *Populus* species

| | m$^3$ | | | |
|---|---|---|---|---|
| Year | 2004 | 2005 | 2006 | 2007 |
| Import - Lumber, poplar, aspen & cottonwood, | 258,125 | 199,691 | 73,271 | 124,929 |
| Export - Lumber, poplar, aspen & cottonwood, | 585,684 | 525,244 | 404,590 | 217,287 |
| | | | | |
| **Net Export** - Lumber, poplar, aspen & | **327,559** | **325,553** | **331,319** | **92,358** |

### 5.2.3 PLANTING STOCK

There are no statistics on the export of *Populus* planting stock during 2004 to 2007. Over the period 2004 to 2007 the import of *Populus* planting stock ranged from a low of 77,000 to a high of 199,000 live plants or unrooted cuttings. Statistics Canada does not provide documentation for what purposes this stock was imported.

## *5.3 PROVINCIAL STATISTICS*

The provincial inventory data for *Populus* species were discussed in 'Forest Inventories – Canada' (see 5.1). The following section on provincial statistics reviews additional information on inventories (where relevant), allowable annual cut (AAC) information and harvest levels. Forest statistics can be found in the National Forestry Database (NFDP); however, the database does not report much information that is useful for this report. The Canadian Council of Forest Ministers (CCFM) created the NFDP with the objectives:

a) "*To describe forest management and its impact on the forest resource*";
b) "*To develop a public information program based on the database*";

c) "*To provide reliable, timely information to the provincial and federal policy processes*".

The program is a partnership between the federal and provincial and territorial governments[1]. The Canadian Forest Service (CFS) at Natural Resources Canada developed and maintains the database and has the responsibility for disseminating national forestry statistics. Unfortunately the various data tables are not broken down by species and only list the species groups 'Softwoods' and 'Hardwoods'. Production data for aspen and poplar are therefore not available on a national or provincial basis from this source.

Below follow some excerpts for several provinces that do provide detailed information through their respective websites and publications. As was the case for the 2004 report, the information pertaining to *Populus* species provided by the Province of Quebec is the most comprehensive of all provinces. There is little consistency between provinces in how they report, and direct comparisons are therefore difficult and may not be meaningful.

### 5.3.1 BRITISH COLUMBIA STATISTICS

The Province of British Columbia (BC) does have a good system of websites on forest management[2] and forest statistics are up-to-date. A few old statistics pertaining to balsam poplar and cottonwood inventories in BC are reported in a 1996 publication[3]. It estimates a total of 236 thousand hectares of stands where cottonwoods and balsam poplars are the lead species. The associated volume is estimated at 43.7 million $m^3$, of which over 88% is either mature or over-mature at age 81+ years. A comparison with the statistics in Appendices II and III is difficult to make. There is a similar publication for aspen, but it provides no inventory data.

The allowable annual cut (AAC) figures for British Columbia, as reported in the NFDP for the year 2007, show the hardwood AAC at 2.3 million $m^3$ for Provincial Crown land. This is well below the level reported in the 2004 report at 3.2 million $m^3$ for Provincial Crown land. It is unclear what portion pertains to *Populus* species. The reasons for this decline are unknown, but could well be the result of balancing the AAC over time.

The total deciduous[4] volume harvest on all lands (Crown, private, federal, First Nations etc.) averages 2.9 million $m^3$ annually[5] over a 4-year period and is a slight increase over the average of 2.6 million $m^3$ for the previous 3-year period reported in the 2004 report.

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[1] http://nfdp.ccfm.org/index_e.php

[2] http://www.for.gov.bc.ca/mof/annualreports.htm

[3] Black Cottonwood and Balsam Poplar Managers' Handbook for British Columbia – FRDA Report 250. This report can be downloaded from the web: http://www.for.gov.bc.ca/hfd/pubs/Docs/Frr/Frr250.htm.

[4] The term deciduous is used throughout this report and refers to the hardwood or broadleaved species present in the inventory; it does **not** include such species as *Larix*. The terms hardwood and deciduous are used interchangeably.

[5] .2003-2004, 2004-2005, 2005-2006 and 2006-2007 Annual Report BC Ministry of Forests - http://www.for.gov.bc.ca/mof/annualreports.htm.

Only one reporting period (2004-2005 fiscal year) shows a breakdown by species. The total deciduous harvested volume was 3.3 million $m^3$, consisting of 71% aspen (*Populus tremuloides*), 14% cottonwood (*P. trichocarpa* and *P. balsamifera*) and 15% other deciduous species.

The average annual *Populus* harvest[1] is 2.6 million $m^3$ over a 4-year period (Appendix V); this is a 37% increase over the average volume harvested during the preceding 4-year period. It accounts for 90% of the total hardwood harvest and approximately 3.1% of the total annual harvest of 82.6 million $m^3$ for all species on all forestland in British Columbia averaged over the 4-year period.

Aspen (*Populus tremuloides*) harvest volume takes up 82.8% of all *Populus* species harvested.

### 5.3.2 ALBERTA STATISTICS

Few statistics are reported on the Website of Sustainable Resource Development[2] of the Government of Alberta and none of the statistics appear to apply to private forestland. The 2008 publication appears to be the most recent report. It states the AAC and annual harvest levels for the fiscal years spanning 2006 and 2007 for coniferous and deciduous species. The total AAC for 2006-2007 is 27.2 million $m^3$, which is an increase from 23 to 24 million $m^3$ set in the period 2001-2002 (annually). The deciduous AAC is set at 11.2 million $m^3$, which corresponds with the NFDP reported AAC[3] for Alberta's potential hardwood harvest. Using a conservative estimate of 80% *Populus* species in the hardwood category, a reasonable estimate of the *Populus* AAC on Crown land is 9.0 million $m^3$.

The harvest volumes (all species) show a steady increase from 14 million $m^3$ in the 1995-1996 fiscal year to 18 million $m^3$ in the 2000-2001 fiscal year and to 25.1 and 23.0 million $m^3$ for 2006 and 2007 respectively, which are still below the AAC of 27.3 million $m^3$. The harvest levels for the deciduous component are 9.6 and 8.4 million $m^3$ for 2006 and 2007 respectively, which are also well within the AAC level of 11.2 million $m^3$.

### 5.3.3 SASKATCHEWAN STATISTICS

The Report on Saskatchewan's Forests- March 2007[4] only lists data for Provincial Crown lands. The AAC for Forest Management Agreements (20-year agreements) and Term Supply Licenses (with terms of up to 10 years) was set at 7.0 million $m^3$ (all species), with the AAC for the hardwood proportion at 3.2 million $m^3$. The NFDP-reported AAC[5] for hardwoods for the period 2006-2007 was estimated at 3.5 million $m^3$ (annually).

[1] http://www15.for.gov.bc.ca/hbs/.
[2] http://www.srd.gov.ab.ca/ - 2008 Publication "Economic Impact of the Alberta Forest Industry"
[3] http://nfdp.ccfm.org/index_e.php.
[4] http://www.environment.gov.sk.ca/Default.aspx?DN=58e05c2b-42ec-4102-b702-b0bbab36eb70.
[5] http://nfdp.ccfm.org/index_e.php.

The same report states that the volume of coniferous species makes up 55% of the total inventory of the 'managed commercial forest'; the deciduous component accounts for 45% of this volume. The 45% deciduous consists of 82% aspen and 10% balsam poplar. Assuming these proportions are distributed evenly over the forest, the hardwood AAC of 3.2 million $m^3$ consists of 92% *Populus* species, or 2.9 million $m^3$ annually. This estimate is close to the 2.8 million $m^3$ AAC reported in the 2004 report.

Harvest data are not reported by species. The average harvest of all species over a 3-year period[1] on the Forest Management Agreements was 4.3 million m3. Assuming the proportion of *Populus* species reflects their presence in the inventory, the total average harvest of *Populus* can be estimated at 1.8 million $m^3$ annually and thus is well below the estimated AAC level of 2.9 million $m^3$.

### 5.3.4 MANITOBA STATISTICS

The total AAC for hardwood on Provincial Crown land in 2006 was set at 2.7 million $m^3$. A conservative assumption is that *Populus* species make up at least 80% of this volume, or 2.2 million $m^3$. The total estimated potential harvest (the sum total of Crown AAC plus private land harvest) of hardwoods is estimated at 3.3 million $m^3$, with the *Populus* share at an estimated 2.6 million $m^3$ for both Crown and private forestland.

Manitoba Conservation - Forestry Branch - reported[2] an average harvest of 2.4 million $m^3$ of coniferous and hardwood species over a 3-year period; the hardwood harvest amounted to 753 thousand $m^3$, which is well below the AAC level for Provincial Crown land. Private forestland managed as woodlots fall under the Manitoba Agro Woodlot Program. It is funded through the Agricultural Policy Framework, which is a federal-provincial initiative. The Manitoba Agro Woodlot Program falls under Manitoba Agriculture, Food and Rural Initiatives (MAFRI)[3] Programs under this initiative are delivered through by MAFRI and the Manitoba Forestry Association. Hardwood harvest statistics for private land in Manitoba could not be located. The NFDP did not list any volume harvested on private land[4].

### 5.3.5 ONTARIO STATISTICS

The allowable annual cut on Provincial Crown land for hardwoods in Ontario is estimated at 11.1 million $m^3$ for the fiscal year 2006-2007. The weighted average volume of *Populus* species harvested off Provincial Crown lands over the period 2001-2002 through 2005-2006 accounts for 79% of the total hardwood volumes harvested[5]. Therefore it is reasonable to assume that the estimated AAC for *Populus* is approximately 8.8 million $m^3$.

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[1] 2003-2004, 2004-2005 and 2005-2006. Source: Report on Saskatchewan's Forests- March 2007.
[2] http://www.gov.mb.ca/conservation/forestry/pdf/5year.pdf
[3] http://www.gov.mb.ca/agriculture/woodlot/index.html.
[4] http://nfdp.ccfm.org/compendium/data/2008_06/detailed/p512_07.pdf.
[5] http://www.mnr.gov.on.ca/241357.pdf.

There are few statistics on private managed forestland and no statistics by species harvested. It is estimated that private lands contribute 16% of the total harvest for all species in Ontario[1] and between 23 and 27% of the total harvested volume of all species on all ownerships is accounted for by hardwood production from private lands in 2004 and 2005. Private wood transported from the province or wood not processed at an Ontario facility is not included in the provincial statistics.

For Provincial Crown lands the statistics are reported in the 2005-2006 annual report obtainable through the government website[2]. Over the period 2001-2002 through 2005-2006, the average harvested volume of *Populus* species is 5.0 million $m^3$ annually, which is well below the estimated 8.8 million $m^3$ AAC for *Populus* species.

In the section 'Forest Inventories – Canada' (see 5.1), it could be concluded that 85% of the *Populus* volume can reasonably be attributed to trembling aspen and Ontario's volume of trembling aspen should therefore be close to 1.2 billion $m^3$ out of a total volume of *Populus* of 1.4 billion $m^3$. The 1.4 billion $m^3$ of *Populus* was reported through CanFI 2001 (Appendix III).

### 5.3.6 QUEBEC STATISTICS

The Province of Quebec has an excellent website in the English language that provides a gateway to useful information[3].

A summary of detailed information for Quebec is reported in Appendix VI. As of the 31st of March 2007, Quebec's AAC totalled 47.2 million $m^3$ for all species, of which poplars account for 5.8 million $m^3$ or 12.3%[4]. The level of AAC has declined slightly from the level reported in the 2004 report (6 million $m^3$). The AAC of *Populus* on public and private forestland is 3.5 and 2.3 million $m^3$ respectively.

Timber harvested in the 2006-2007 fiscal year totalled 33.0 million $m^3$, of which *Populus* represents 3.6 million $m^3$, which is 62% of the AAC level for *Populus* province-wide.

Total consumption of *Populus* species by the wood using industry in Quebec in 2005 and 2006 was 5.1 and 5.0 million $m^3$ respectively. Although the time periods cannot be compared directly, annual consumption exceeds the reported harvest volume for *Populus* species and the shortfall must have come from outside sources. For 2005 and 2006 the net import of hardwood volume averaged 3.3 million $m^3$ and includes poplar volume. Most imports were from the US and Ontario.

[1] http://www.mnr.gov.on.ca/241357.pdf.
[2] http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/241358.html.
[3] http://www.mrn.gouv.qc.ca/english/forest/quebec/quebec-system-management.jsp
[4] http://www.mrn.gouv.qc.ca/english/publications/forest/publications/stat_edition_resumee/resumeanglais2008.pdf.

# 6 TECHNICAL INFORMATION

## *6.1 IDENTIFICATION, REGISTRATION AND CONTROL OF CLONES*

Canada has no national regulations for the identification, registration or control of *Populus* or *Salix* clones. Although Canada has the 1990 Plant Breeders' Rights Act[1], it only applies to certain species prescribed by its regulations. Neither *Populus* nor *Salix* are on this list.

*Populus* and *Salix* clones can and are widely propagated vegetatively for various purposes without any legal protection of intellectual property rights for the breeder, unless specific contractual arrangements are in place. There is also no mechanism to ensure the origin and clonal identities of *Populus* or *Salix* clones. Several years ago the Poplar Council of Canada attempted to introduce a voluntary Certification Service, under which commercial nurseries could register certified clones. The Certification Service did not find support from the nursery industry and the initiative did not succeed.

Nursery-produced clonal planting stock has been known to be contaminated with unknown clones. This continues to be a common occurrence, primarily stemming from a lack of quality control at the nursery level. The problem is solvable and most corporate clients with large poplar plantation or crop interests insist on improved quality control mechanisms, which frequently include genotyping technology. The cost of this technology is rapidly decreasing; however, it may still be out of reach for the small land owner wanting to plant a small amount of poplar or willow.

Several provinces in Canada have regulations pertaining to deployment of exotic species, e.g. hybrid *Populus* clones, on Crown land.

### 6.1.1 PROVINCE OF BRITISH COLUMBIA

Hybrid poplar stock to be deployed on Crown lands in British Columbia has to be registered[2]. The registration standards exempt hybrid poplar from the genetic diversity requirements, which permits it to be deployed in pure clonal blocks not exceeding 10 hectares in size[3]. Hybrid poplar can therefore be deployed on Crown lands in British Columbia, provided it meets the Ministry of Forests and Range recommendations for specified geographic areas[4]. The regulations do not cover *Salix* species as these are not considered a commercial forest species in British Columbia.

There are no standards for private land and landowners can plant exotic and hybrid poplar and willow trees without restrictions.

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[1] See http://laws.justice.gc.ca/en/P-14.6/ for the Act.
[2] http://www.for.gov.bc.ca/hti/treeseed/tech.htm
[3] Dan Carson – personal communication.
[4] Guidebook Update #2 - http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/veg/seedtoc.htm.

### 6.1.2 PROVINCE OF ALBERTA

Alberta Sustainable Resource Development introduced a 'Standards for Tree Improvement in Alberta' manual in 2003 (revised in 2005), covering planting and regeneration of genetically improved tree stock on Provincial Crown land. The manual covers traditional plant breeding techniques only[1]. It lists specific standards for tree improvement and deployment for *Populus* – both aspen and poplar –, as well as *Picea* and *Pinus* species. The standards apply to Crown lands in the so-called Green Area. Currently hybrid poplars are not allowed to be planted on an operational scale on Provincial Crown land in the so-called Green and White Areas[2] (see 6.3.3.1). This restricts deployment of hybrid poplar and aspen to private lands only. Planting of monoclonal blocks (even of native material) is not permitted on Crown land; clones of native material can only be deployed in intimate clonal mixes, consisting of a minimum of 18 clones[3].

There are no such restrictions on private land.

### 6.1.3 PROVINCE OF QUEBEC

The Ministry of Natural Resources and Wildlife, «Ministère des Ressources naturelles, de la Faune et des Parcs» (MRNFP) in Quebec has been actively breeding and selecting hybrid poplar for use in the province since 1969 (see 6.3.1.1) and keeps firm control of the hybrid poplar resource under its jurisdiction. Since the MRNFP provides free-of-charge hybrid poplar planting stock to companies that operate on Provincial public lands, as well as to eligible private forestland owners, it controls the production of planting stock and thus the deployment of hybrid poplar clones on both public and private land. Hybrid poplar clones are not made available to clients from outside the Province.

### 6.1.4 POPLAR COUNCIL OF CANADA (PCC)

Besides the unsuccessful attempt to introduce a voluntary Certification Service for poplar clones, the PCC has no jurisdiction over the identification, registration and control of poplar clones in Canada.

As reported by Jim Richardson (Technical Director – PCC, see 9), "*The Genetics and Breeding Working Group of PCC has successfully completed a major up-date and improvement of the Council's poplar and willow clone directory, previously available only in hard copy dating from 1986*[4]. *The directory is now available in searchable electronic database format on the PCC website, where access is limited to members only*[5]. *Related databases of public and private organizations involved in poplar breeding in Canada have been incorporated*".

[1] http://www.abtreegene.com/images/STIA.pdf.
[2] Barb Thomas – personal communication.
[3] Tim Gylander – personal communication.
[4] Register of Populus and Salix 1986 – Edited by: Louis Zsuffa
[5] www.poplar.ca.

### 6.1.5 PRAIRIE FARM REHABILITATION ADMINISTRATION – SHELTERBELT CENTRE

The Shelterbelt Centre of the Prairie Farm Rehabilitation Administration (PFRA) of Agriculture and Agri-Food Canada (AAFC) at Indian Head (Saskatchewan) is the only federal government agency involved in selection, breeding (see 6.3.1.2) and distribution of hybrid poplar clones. It has recently also embarked on willow selection for future use. Its mandate covers the development of new poplar and willow clones for use in farm shelterbelts and associated environmental projects, such as riparian restoration. PFRA has a regional mandate (the Prairie region), national responsibilities and is involved internationally in several projects[1].

PFRA does not have a mandate to provide hybrid poplar or willow clones to clients who establish SRIC woody crops or forest plantations for fibre or biomass production. Once the clones are released for use, they are in the public domain and as such PFRA does have control over the distribution of planting material originating from its nursery, but not over any vegetative propagation originating from established shelterbelts or private stoolbeds. Planting stock is free-of-charge to eligible land owners, as is technical assistance[2].

## *6.2 CONSERVATION OF POPULUS AND SALIX GENETIC RESOURCES*

Several Government agencies have been actively involved in the collection and conservation of genotypes of *Populus trichocarpa* (black cottonwood), *Populus balsamifera* (balsam poplar) and *Populus deltoides* (var. *monilifera*, a.k.a. *P. deltoides* var. *occidentalis* or Plains cottonwood).

### 6.2.1 POPULUS TRICHOCARPA

The British Columbia Ministry of Forests and Range (MOF), Research Branch in Victoria (British Columbia) completed a common-garden trial a few years ago with coastal *Populus trichocarpa*, and selected material that was subsequently planted in three distinct locations in British Columbia. The trials include selections from eight populations from Oregon, Washington and coastal British Columbia[3].

The MOF also collected *Populus trichocarpa* from the interior of British Columbia and that collection was planted in one of the three locations in the Province[4].

The material will be utilized in the future for environmental purposes, such as riparian restoration, and will also be available for future breeding purposes.

[1] http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1187362338955&lang=e.
[2] http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1180103439791&lang=e.
[3] Chang-Yi Xie – personal communication.
[4] Michael Carlson – personal communication.

### 6.2.2 POPULUS BALSAMIFERA AND POPULUS DELTOIDES

The Shelterbelt Centre of the Prairie Farm Rehabilitation Administration (PFRA) of Agriculture and Agri-Food Canada (AAFC) at Indian Head (Saskatchewan) made collections of *Populus balsamifera* from a range across Canada and Alaska (the AgCanBaP collection). Clonebanks are being established at four locations across the country. The plan is to initially make selections from this collection based on local outplanting trials (clonal trials), followed by intra-specific hybridization between distinct populations.

In early 2008 PFRA collected *Populus deltoides* var. *monilifera* (a.k.a. *P. deltoides* var. *occidentalis* or Plains cottonwood) along the South Saskatchewan River drainage in the southern Canadian Prairie Region. This collection was augmented with *Populus deltoides* var. *monilifera* from the US Great Plains. Selections from this *deltoides* collection will be used for intra-specific hybridization between distinct *P deltoides* populations.

Besides the need for genotype conservation in both species, one of the objectives is to use the material for environmental projects, such as riparian restoration and shelterbelt use. This material will also be made available as breeding stock for SRIC hybrid poplar crops and poplar plantations.

### 6.2.3 SALIX SPECIES

Since 2004 the Canadian Forest Service, Atlantic Forestry Centre in Fredericton (New Brunswick) has collected material of seven native willow species and has been studying the genetic variation between and within species populations[1]. The objectives are mainly aimed at ecological uses of native willow species in riparian zone restoration and phytoremediation. One interesting use is in bee pollination in blueberry production. The CFS is making willow clones available to blueberry farmers for bee pollination; willows are largely insect-pollinated and provide an early food source for bees.

Also of great interest are traits related to biomass production. The Canadian Forest Service has exchanged material with several interested parties for field testing and further work, including future breeding and hybridization. The CFS is pursuing additional research objectives with the species and is very interested in cooperating with industry to advance the species as a source of biomass.

## *6.3 SELECTION AND BREEDING*

### 6.3.1 GOVERNMENTS - SELECTION & BREEDING PROGRAMS

Only two Government organizations in Canada are involved in the breeding of hybrid poplar clones, the Provincial Ministry of Natural Resources and Wildlife, «Ministère des Ressources naturelles, de la Faune» (MRNF) in Quebec and the federal Prairie Farm

[1] Alex Mosseler – personal communication.

Rehabilitation Administration, Shelterbelt Centre (PFRA) of Agriculture and Agri-Food Canada (AAFC) in Saskatchewan, albeit with different objectives.

Two Government of Canada organizations are involved with selection of willow. The Canadian Forest Service, Atlantic Forestry Centre in Fredericton (New Brunswick) (see 6.2.3) and federal Prairie Farm Rehabilitation Administration, Shelterbelt Centre (PFRA) of Agriculture and Agri-Food Canada (AAFC) in Saskatchewan

#### 6.3.1.1 Ministry of Natural Resources and Wildlife (MRNF) – Quebec

The «Direction de la recherche forestière » (DRF) of the «ministère des Ressources naturelles et de la Faune» (MRNF) has been involved in a hybrid poplar breeding and improvement program since 1969[1]. The program has been producing superior hybrid poplar clones for deployment on both Provincial public and private lands. Selected clones are suited to the highly varied growing conditions in Quebec.

The following selection criteria are used: Growth, cold tolerance, tree form, disease and insect resistance, site adaptability and wood quality.

Five poplar species are used for hybridization: *Populus deltoides*, *P. balsamifera*, *P. maximowiczii*, *P. trichocarpa*, and *P. nigra*. Several hybrid aspen clones were also produced: *P. alba* × P. *grandidentata* and *P. tremula* × *P. tremuloides*. The DRF currently has in excess of 5,000 clones under evaluation and the program has more than 40 operational hybrid poplar clones (*Aigeiros-Tacamahaca* hybrids) available for deployment. To maintain genetic diversity, the DRF strives for 6-19 clones per planting region.

For southern Quebec the presence of *Septoria musiva* (stem canker) drives the breeding and selection of new clones. Eighteen clones of clone types[2] DN,TD, DNxM, NM and BM have been identified due to their resistance to *Septoria musiva*. Unfortunately the fast-growing DM hybrid type is too susceptible to *Septoria musiva* to be planted in southern Quebec and it is not cold tolerant enough to be planted in the northern regions where *Septoria musiva* is (still) absent. For the northern regions *P. maximowiczii* hybrids with *P. balsamifera* and *P. trichocarpa* are suitable.

Discussions about future cooperation between MRNF and Alberta-Pacific Forest Industries Inc. (Al-Pac) were initiated for new hybrid poplar breeding[3], as many similar challenges are being faced by MRNF and Al-Pac.

[1] http://www.mrn.gouv.qc.ca/carrefour/english/document/poplar-guide.pdf - The Poplar breeding program in Québec (Pierre Périnet).

[2] DN = *P. deltoides* × *P. nigra*; TD = *P. trichocarpa* × *P. deltoides*; DN×M = DN × *P. maximowiczii*; NM = *P. nigra* × *P. maximowiczii*; BM = *P. balsamifera* × *P. maximowiczii*; DM = *P. deltoides* × *P. maximowiczii*.

[3] Barb Thomas – personal communication.

### 6.3.1.2 Prairie Farm Rehabilitation Administration (PFRA) – Shelterbelt Centre – Saskatchewan

One of the Prairie Farm Rehabilitation Administration (PFRA), Shelterbelt Centre's mandates is to develop new poplar clones for use in shelterbelts and associated environmental projects (see 6.1.5).

The PFRA has also been involved in a cost-share breeding program with Alberta-Pacific Forest Industries Inc. (Al-Pac) to create new hybrid poplars for SRIC hybrid poplar crops. The resulting hybrid poplar clones are still under test at PFRA and Al-Pac. PFRA may make selected and well-performing individual clones available for distribution through the nursery industry for ornamental or industrial plantings[1].

The recent initiatives of genotype conservation of *Populus balsamifera* and *P. deltoides* (var. *monilifera*) will eventually lead to intra-specific hybridization between distinct populations (within the species) as a first step. Emphasis will be on growth performance, drought tolerance, cold tolerance, and disease resistance (especially *Septoria musiva* resistance or tolerance); of secondary interest is wood quality. The second step will involve inter-specific breeding of *Populus deltoides* × *P. balsamifera* (DB)[2], hybrids with *P. maximowiczii* and hybrids with *P. nigra* and *P. laurifolia*[3]. Of great concern is the susceptibility to *Septoria musiva* (stem canker), which has been steadily spreading across the Prairie region, possibly due to an increase in the amount of recently established SRIC hybrid poplar crops.

PFRA has also started selection and breeding work with willow material originating from the Canadian Forest Service (CFS), Atlantic Forestry Centre in Fredericton (New Brunswick) (see 6.2.3). The breeding program with willow is primarily focused on environmental and biomass production opportunities[4].

The CFS in Fredericton (NB) and PFRA (Indian Head, SK) collected native willow species, primarily *Salix discolor* (a.k.a. Pussy willow) from across Canada, and *Salix eriocephala* (Heartleaf willow) over a range from Saskatchewan to the Atlantic Provinces. This collection is co-located at the CFS in Fredericton (NB) and the PFRA Shelterbelt Centre and is managed in common gardens. PFRA is mostly interested in willows that are well adapted to the drier upland sites of riparian areas. Selection emphasis will be on growth performance, drought tolerance, cold tolerance and disease resistance (especially *Melampsora* leaf rust resistance or tolerance).

As with the poplars, the main focus will be on environmental and biomass applications of willows. Applications like riparian restoration will restrict the choice of material to native North American genotypes. *Salix discolor* and *Salix eriocephala* will be the two species used in their respective intra-specific breeding programs to create superior willow clones for various environmental uses, with a spin-off for use in operational biomass crops.

[1] Bill Schroeder, John Kort – personal communication – 2004.
[2] The reverse BD cross will often not succeed unless embryo rescue is used.
[3] Bill Schroeder – personal communication.
[4] Bill Schroeder – personal communication.

## 6.3.2 HYBRID POPLAR - CORPORATE SELECTION & BREEDING PROGRAMS

### 6.3.2.1 Alberta-Pacific Forest Industries Inc. (Al-Pac) – Alberta

In 2001 Alberta-Pacific Forest Industries Inc. (Al-Pac) entered into a cost-sharing hybrid poplar breeding project with the PFRA[1]; breeding took place in 2001, 2002 and 2003. Al-Pac has taken possession of half the breeding results and is currently testing the material. Suitable clones will eventually be deployed in the company's SRIC hybrid poplar crop farming operations. Although there are no immediate plans to renew this partnership for additional breeding, the interest for cooperation remains high and discussions for further cooperation are ongoing. Al-Pac has also entered into discussions with the «Direction de la recherche forestière» (DRF) of the «ministère des Ressources naturelles et de la Faune» (MRNF) in Quebec for possible cooperation in new breeding[2].

The company embarked on an intraspecific improvement project for *Populus balsamifera*, balsam poplar, using material from widely dispersed North American sources. Balsam poplar is not only useable as parental material for a hybrid poplar breeding project, but also for reforestation, and landing and road rehabilitation projects on the Forest Management Agreement area in the so-called Green Area (Provincial Crown lands). Improved balsam poplar may eventually find its way into the company's hybrid poplar breeding program.

### 6.3.2.2 Kruger Products Limited – British Columbia

Kruger Inc. purchased Scott Paper Ltd. in 1997 and changed the name of its Canadian acquisition in 2006 to Kruger Products Limited. Kruger Products cites the shortage of new suitable clones as one of the most pressing issues the company's poplar plantation management and SRIC hybrid poplar crop programs face. Kruger Products continues to test and select hybrid poplar clones from the University of Washington's 'Poplar Molecular Genetics Cooperative' (PMGC)[3] breeding program, of which Scott Paper was a member. Several clones originated from the exploratory breeding program carried out by MacMillan Bloedel Poplar Farms in 1996 (see 6.3.2.3).

The company initiated a small hybrid poplar breeding project in 2003 to create and select hybrid poplars cold-hardy enough to be deployed on alluvial floodplain lands in several coastal river drainages (100 to 200 km north of Vancouver), where the company manages part of its deciduous Tree Farm Licence. Most hybrid poplar clones created in 2003 are euramerican hybrids between *Populus trichocarpa* (♀) and *P. nigra* (♂); a few are interamerican (*Populus*. ×*generosa*) between *Populus trichocarpa* (♀) and *P. deltoides* (♂). The female *P. trichocarpa* parents are selections from these river drainages. The

[1] Barb Thomas, Bill Schroeder – personal communication.
[2] Barb Thomas – personal communication.
[3] The Poplar Molecular Genetics Cooperative (PMGC) of the University of Washington completed its work several years ago. The cooperative does not exit anymore.

hybrids are currently being tested at the company's nursery facility and will eventually be deployed in the up-coast river drainages[1].

Unfortunately the disease *Septoria musiva* was identified as the cause of stem cankers in many of the clones under test (see 6.5.1.1) at the company's nursery site near Harrison Mills, British Columbia. In a thorough field review in 2007, several well-performing new clones in a clone-site trial were found to be completely free of any cankers and this included several *Populus trichocarpa* × P. *deltoides* hybrids.

### 6.3.2.3 Poplar Farms Division – British Columbia

In 1996 Poplar Farms Division (PFD), originally an incorporated operating division of MacMillan Bloedel Ltd[2]., initiated a small breeding project that resulted in several promising hybrid poplar clones. Declining interest by MacMillan Bloedel successor companies, that still controlled PFD, halted further efforts and were not prepared to recover their clones. SilviConsult Woody Crops Technology Inc. of Nanaimo, British Columbia, recovered the best selections for archiving at Kruger Products Limited, at the Ministry of Forests and Range, Kalamalka Forestry Centre near Vernon (British Columbia) and at Washington State University in Puyallup (Washington State, USA). Several of these recovered *Populus trichocarpa* × P. *deltoides* clones were selected by Kruger Products and to date have proved to be *Septoria*-free.

### 6.3.2.4 Western Boreal Aspen Corporation (WBAC) - Alberta

The Western Boreal Aspen Corporation (WBAC) incorporated in 2000 and as of the end of 2007 was owned and operated by two forest companies[3]. The corporation started as a cooperative in 1994 with the goals of developing fast-growing trembling aspen and hybrid aspen (see 6.3.3.1).

Besides aspen, WBAC also carried out breeding of hybrid poplar in 2006, using the native balsam poplar (*Populus balsamifera*) as female parents, crossed with *Populus deltoides* males from US collaborators. This mating combination did not result in any viable seed. The conclusion was that the reciprocal cross would be more successful. Other crosses made with pollen from *Populus maximowiczii*[4] and *P. simonii* were successful.

## 6.3.3 ASPEN - CORPORATE SELECTION & BREEDING PROGRAMS

Two organizations are involved in aspen tree improvement; both are located in the province of Alberta.

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[1] Dan Carson – personal communication.

[2] MacMillan Bloedel Ltd. spun off PFD to Pacifica Papers Inc., a company that was subsequently absorbed into NorskeCanada. NorskeCanada became part of Catalyst Paper Corporation.

[3] Daishowa-Marubeni International Ltd. and Weyerhaeuser Company Limited. Ainsworth Engineered Canada LP resigned at the end of 2007 and Footner Forest Products Ltd., which joined WBAC in 2003, resigned from the corporation in 2006.

[4] WBAC refers to *Populus ussuriensis*. *Populus ussuriensi* is actually *P. maximowiczii*.

### 6.3.3.1 Western Boreal Aspen Corporation (WBAC) – Alberta

The Western Boreal Aspen Corporation (WBAC) was established to develop fast-growing trembling aspen and hybrid aspen, and to research and develop propagation and silvicultural techniques to grow and establish "*improved aspen in plantations and in cut blocks*"[1].

The mission statement in the 2007 Annual Report[2] states: "*To develop genetically improved aspen and support research towards achieving successful deployment to support participants' fibre needs. As a secondary focus, the corporation will address poplar tree improvement*". Note that in this context poplar is *Populus balsamifera* or balsam poplar (see 6.3.2.4).

WBAC has over 20 hectares of native aspen (*Populus tremuloides*) clone trials, 15 hectares of hybrid aspen and land race trials, 21 hectares of progeny tests and 18 hectares of silviculture and provenance trials. Close to 1,500 native aspen phenotypic selections were made by WBAC and its former members.

WBAC completed a large native aspen breeding program in 2004. In 2006 it completed a hybrid aspen breeding project. *Populus tremuloides* and *P. tremula* (var. *davidiana*) females were crossed with *Populus tremuloides*, and *P. tremula* (including var. *davidiana*) pollen from Finland, China and Korea.

The greatest bottleneck to large-scale deployment of selected (hybrid) aspen clones is the absence of a cost-effective mass vegetative-propagation method to effectively capture clonal genetic gain, or hybrid vigour in the case of hybrid aspen. WBAC has been working on several methods based on root cultures and root cuttings that show promise. A close liaison is maintained with the University of Alberta in solving questions on vegetative propagation using root cultures.[3]

The WBAC member companies' long term objectives include planting "*improved aspen in plantations and in cut blocks*" and most of this planting would occur on the long term Forest Management Licences located on Provincial Crown land in the Green Area. Current standards for the deployment of improved genetic material on Provincial Crown lands prove very onerous and "obstructive"[4]. In the case of deploying hybrid aspen (or hybrid poplar), current regulations do not allow hybrids to be planted on an operational scale on Provincial Crown land in the so-called Green and White Areas[5] (see 6.1.2).

### 6.3.3.2 Alberta-Pacific Forest Industries Inc. (Al-Pac) – Alberta

Alberta-Pacific Forest Industries Inc. (Al-Pac) is also involved in breeding of hybrid aspen. Several hybrid combinations have been bred in controlled crosses, using *Populus tremuloides* and *P. tremula*, including *P. tremula* var. *davidiana*; the latter with both male

[1] Western Boreal Aspen Cooperative – Annual Report January 1 1994 - December 31 1995.
[2] Western Boreal Aspen Corp. – 2007 Annual Report.
[3] Western Boreal Aspen Corp. – 2005 Annual Report
[4] Western Boreal Aspen Corp. – 2007 Annual Report.
[5] Barb Thomas – personal communication.

and female parents in a cross with *P. tremuloides*. The company has used *P. tremula* pollen from Finland and has an established orchard of *P. tremula* var. *davidiana*.

Al-Pac is currently adding a small amount of its hybrid aspen in clonal blocks to its operational SRIC hybrid poplar crops to gain experience in managing this new crop. The company is also concerned about the standards for the deployment of improved genetic material on Provincial Crown lands as discussed in 6.3.3.1.

## *6.4 CULTIVATION OF POPLAR*

This section deals predominantly with poplar cultivation. Section 6.4.3 contains a brief outline on SRIC willow crop opportunities.

### 6.4.1 NURSERY STOCK TYPES AND PRODUCTION

*Populus* stock types vary depending on the region, the general availability of clones and the *Populus* species. *Salix* species are generally planted in high density SRIC biomass crops and are established using unrooted dormant cuttings.

#### 6.4.1.1 Aspen

For aspen the stock type has to be a rooted plant, either a bareroot or container plant. Aspen does not root from an unrooted stem cutting and this is a distinct disadvantage from a tree improvement and an operational perspective. For tree improvement and subsequent planting trials, it is critical to have access to uniform clonal material. To fully benefit from the yield gains through heterosis of selected hybrid clones, an efficient and low-cost vegetative mass propagation technology is required to allow operational clonal plantings (see 6.3.3.1).

Currently there are no operational SRIC aspen crops or aspen forest plantations in the Prairie region of Canada. All planting is still experimental.

#### 6.4.1.2 Poplar (non-aspen)

Ease of rooting is one of the criteria that determine the choice of stock type for poplar. It varies with species; for instance *Populus deltoides* is usually a problematic rooter, whereas *P. trichocarpa* is a very prolific rooter. Many of the hybrid clones are reasonable rooters; however, ease of rooting does vary by clone.

##### *6.4.1.2.1 British Columbia*

In British Columbia the stock type of choice is a 1-year old unrooted, dormant cutting or whip. Cuttings (approximately 30 to 90 cm long) are used when establishing SRIC hybrid poplar crops, where site preparation and weed control can be optimized in a farm setting. For plantations that cannot be managed as intensively, e.g. forest plantations, unrooted whips (1.5 to 1.8 m long) are best when some height is needed to dominate the weed competition.

#### 6.4.1.2.1.1 Kruger Products Limited - New Westminster, B.C.

Kruger Products Limited uses unrooted cuttings for its SRIC hybrid poplar crops and whips for its forest plantations. First generation SRIC hybrid poplar crops are planted on farmland and can be intensively weeded, whereas second rotation SRIC crops do not have complete site preparation due to the high cost of stump removal. In that situation the company has lately been using 90 cm long unrooted cuttings with the bottom 30 to 45 cm planted in the soil[1]; this has proven a successful approach and works best with spot site preparation.

Kruger Products has the only major poplar nursery in British Columbia. It meets all its own annual requirements for cuttings and whips, and produces some stock for outside sales.

### *6.4.1.2.2 Prairie Provinces*

#### 6.4.1.2.2.1 Alberta-Pacific Forest Industries Inc. (Al-Pac) - Boyle, Alberta

In the Prairie Provinces, Alberta-Pacific Forest Industries Inc. (Al-Pac) is the only major corporation that has embarked on a large-scale SRIC hybrid poplar crop operation, using an agronomic approach to poplar crop farming. The company relies on rooted stock, preferably dormant bareroot stock and container-grown rooted stock (in that order). Experience with unrooted cuttings has been poor due to low soil moisture conditions after planting in the spring and early summer; this stock type is no longer in use. All stock is produced by private nurseries under contract with Al-Pac.

Al-Pac uses intensive site preparation and integrated weed control techniques to ensure success of its newly established crops. Survival after the first year runs at 90%, but decreases to approximately 77% by year four[2].

#### 6.4.1.2.2.2 Ainsworth Engineered Canada LP - Grande Prairie, Alberta

Ainsworth Engineered Canada LP in Grande Prairie, Alberta, started work with hybrid poplar in 2006. It followed a similar management regime for SRIC hybrid poplar crops developed by Alberta-Pacific Forest Industries Inc. As is the case with Al-Pac, the company relies on rooted (bareroot and container) stock for planting. Stock is produced by private nurseries under contract with Ainsworth.

### *6.4.1.2.3 Ontario*

#### 6.4.1.2.3.1 Domtar Inc. - Cornwall, Ontario

The poplar operations at Cornwall, Ontario, ceased in 2004 when the pulp mill closed its operations.

[1] Dan Carson – personal communication).
[2] Al Bertschi – personal communication.

### *6.4.1.2.4 Quebec*

#### 6.4.1.2.4.1 Ministry of Natural Resources (MRNF) – Quebec

In Quebec, the « ministère des Ressources naturelles et de la Faune » (MRNF) controls hybrid poplar nursery production and distribution. Since the vast majority of planting in Quebec takes place on forestland and there is a 'no-herbicide' policy in place, large stock is required to ensure survival. The preferred stock type is a steckling, which is essentially the same as a set or rooted whip and varies from 1.2 to 1.8 m in length[1]. The trees are grown in bareroot nurseries for one year from small unrooted cuttings. In the fall the stock is lifted, processed and cold-stored for outplanting the following spring. During the processing the roots are trimmed back to resemble a rough 'bottle brush'[2].

#### 6.4.1.2.4.2 Domtar Inc. - Windsor, Quebec

The company plants hybrid poplar on its private forestlands near Windsor, Quebec. Operations include establishing and managing short rotation hybrid poplar crops on approximately 5% of its private forestland that is deemed suitable for hybrid poplar. These crops are considered forest plantations.

The company plants tall rooted whips (sets), called stecklings in Quebec. The bareroot stecklings are 1.2 – 1.8 m in length and are planted to 30-40 cm depth. The company also plants 1.6 m tall unrooted whips[3]. All planting stock is provided by the «ministère des Ressources naturelles et de la Faune» (MRNF). Forest companies like Domtar contribute to a provincial forest fund that pays for the stock; small landowners can get the trees for free, as long as their land is managed under an approved management plan[4].

#### 6.4.1.2.4.3 Other companies in Quebec

There are several other forest companies in Quebec that have been involved in hybrid poplar plantation establishment. Of several companies contacted besides Domtar Inc., only Norbord Inc.[5] and Norampac Cascades Canada Inc.[6] responded. A request for information from Louisiana Pacific Canada Ltd. went unanswered, probably due to a recently announced closure of its Quebec operations. All these companies plant stock provided through the «ministère des Ressources naturelles et de la Faune» (MRNF) in Quebec. The MRNF controls all the hybrid poplar stock allocations in the Province and stock issued to companies and small private forestland owners is similar to what Domtar Inc. is using on its forestlands in Windsor, Quebec.

## 6.4.2 PLANTATION AND SRIC CROP TENDING ACTIVITIES

The following review of plantation and crop tending activities distinguishes between 'forest plantations' and 'short-rotation-intensive-culture (SRIC) crops', and addresses

[1] Roger Touchette – personal communication)
[2] Personal observation.
[3] Éric Lapointe – personal communication.
[4] Éric Lapointe – personal communication.
[5] Claude LeBel - personal communication.
[6] Danielle Garon - personal communication.

poplar and hybrid poplar. Since poplar plantation statistics are not available through the National Forestry Database (NFDP), the following reports rely on personal communication only. There are no operational aspen or willow crops in Canada; all plantings are still experimental and these crops are not discussed in this section.

### 6.4.2.1 Hybrid Poplar - Forest Plantations

The vast majority of poplars planted on forestland are hybrids. This planting is classed as a reforestation activity (Table 4). The establishment of the main forest plantations with *Populus* species took place in British Columbia and Quebec.

Table 4 - Approximate area of hybrid poplar forest plantations in Canada

| | Forest Plantations | | | |
|---|---|---|---|---|
| | Reported in 2004 for 2000-2003 | Planted 2004-2007 | Total plantations to and incl. 2007 | Planted 2008 |
| Province | Hectares | Hectares | Hectares | Hectares |
| British Columbia (*) | 3,000 | 247 | 3,300 | 42 |
| Quebec (**) | 1,935 | 4,482 | 8,120 | 1,260 |
| **Total** | **4,935** | **4,729** | **11,420** | **1,302** |

(*) British Columbia total includes only Kruger Products Limited forest plantations. The total planted to and including 2007 is an estimate.
(**) Quebec total in 2004 included Norampac Inc. (265 ha), Louisiana-Pacific Canada Ltd. (1,420 ha), Tembec Inc. (250 ha). There was no report from Norbord Inc. in 2004.
Source: Personal communication with Kruger Products Limited (British Columbia) and the «ministère des Ressources naturelles et de la Faune» (MRNF – Quebec)

#### *6.4.2.1.1 British Columbia*

Kruger Products Limited uses tall (1.5 to 1.8 m) dormant unrooted whips that are planted in the spring. It is the only company establishing significant hybrid poplar forest plantations in the province. Kruger Products refers to these plantations as 'extensive' plantations. The company frequently uses a small hydraulic excavator to create 440-450 individual planting spots per hectare by removing harvest debris, competing vegetation and mixing up the humus and mineral soil layers. Where soil conditions are unfavourable (wet ground), planting mounds are created to improve drainage and soil temperature; the stand density could be as low as 280 stems per hectare in this case.

Shortly following planting, planters place a small amount of NPK (9-40-4, plus minor elements) fertilizer close to the root zone at shovel depth. Weed control is done as needed and registered herbicides may be used on plantations located close to the pulp mill near Vancouver. This plantation system has proven successful over time.

The company manages about 3,300 hectares of these forest plantations in coastal British Columbia and plants an average of 75-85 hectares per year[1].

#### *6.4.2.1.2 Quebec*

In Quebec hybrid poplar planting occurs on private and Provincial public forestlands. The preferred stock type is a steckling (rooted whip or set) of 1.2 to 1.8 m in length[2]. Plantations are established to augment wood supplies for pulp and paper mills or OSB plants.

The following companies responded to the request for information:

- Norampac Inc. plantations total 612 hectares by the end of 2007. Planting in 2008 totalled 70 hectares of hybrid poplar[3].
- Domtar Inc. plantations to the end of 2007 total 3,319 hectares. In 2008 the company planted 389 hectares of hybrid poplar forest plantations[4]. The company uses a similar site preparation approach as Kruger Products Limited in British Columbia. It has been using a hydraulic excavator to create plantable spots for its stecklings or unrooted whips. Spot site preparation also facilitates the placement of fertilizer at time of planting. Approximately 250 grams of chemical fertilizer is placed in the rootzone with a planting shovel. The company has been testing various fertilizer formulations.
- Norbord Inc.'s total plantation area is 5 hectares, all planted in the 2004-2007 period. The company did not plant anything in 2008 and has no plans to do so in the future[5].

#### *6.4.2.1.3 Yield, Stand Density and Rotation Length*

Table 5 shows the various mean annual increments, stand densities and rotation lengths of hybrid poplar forest plantations.

In British Columbia, forest ('extensive') plantation densities for Kruger Products Limited range from 280 to 450 stems per hectare, depending on the type and cost of the site preparation[6]. The low stand densities result in fairly large tree sizes, which are desirable for its pulp mill.

Quebec poplar growers are encouraged to establish plantations at 3.0 x 3.0 m plantation spacing, or 1,111 stems per hectare.

[1] Dan Carson – personal communication.
[2] Roger Touchette – personal communication.
[3] Danielle Garon – personal communication.
[4] Éric Lapointe – personal communication).
[5] Claude LeBel – personal communication).
[6] Dan Carson – personal communication.

Table 5 - Yield, stand density and rotation length - Forest plantations

| | Mean Annual Increment – MAI $m^3\ ha^{-1}\ yr^{-1}$ | Stand Density stems per ha (spha) | Rotation Length Year | Comments |
|---|---|---|---|---|
| Kruger Products Ltd. - British Columbia | 15 | 280-450 | 33 (*) | Mounding 280 spha |
| Norampac Inc. - Quebec | 12-15 | 1,111 | 15 | |
| Domtar Inc. - Quebec | 12-15 | 1,111 | 15 | |
| MRNF – Quebec | 8-12 | 1,111 | 15 | Average |
| | 15-20 | | | So. Quebec |

(*) The company expects to decrease this to 22-25 years due to spot site preparation and mounding and the placement of fertilizer at time of planting.
Source: Personal communication with companies and the «ministère des Ressources naturelles et de la Faune» (MRNF – Quebec) in 2007.

### 6.4.2.2 Hybrid Poplar - Short-rotation-intensive-culture (SRIC) crops

*This section was updated on 8 December 2008 for Domtar Inc. in Ontario (see Appendix XI - Update 6.4.2.2).*

SRIC hybrid poplar crops are almost exclusively grown on existing farmland or newly-cleared agricultural class lands in private ownership, using agronomic methods. The land is either owned or leased. Except for a few small private crops of hybrid poplar, currently almost all SRIC hybrid poplar crops in Canada are for the purpose of supplying pulp fibre or logs for engineered wood products, such as panel board or OSB (Table 6).

Catalyst Paper Corporation in British Columbia is harvesting all its SRIC hybrid poplar crops, which are mostly located on leased properties. The company does not intend to re-establish any new SRIC crops.

Domtar Inc. in Ontario has shut down its poplar farming operations indefinitely following the closure of the pulp mill at Cornwall, Ontario. Most of the remaining poplar crops are owned by small private landowners and are still being harvested by a company unrelated to Domtar Inc.[1].

ForestFirst[2] in Prince Albert, Saskatchewan, is a 'not for profit' organization established in 2001 (as the Saskatchewan Forest Centre) with the mandate "*to promote the acquisition, creation and dissemination of knowledge to expand a socially, ecologically, and economically sustainable forest economy*."[3] Its Agroforestry Unit has as objective "*to broaden the economic choices and increase the long term wood supply by demonstrating that trees are a viable crop for farmers and land managers, and providing*

[1] Jim Richardson – personal communication obtained from Brian Barkley, manager of the Eastern Ontario Model Forest.
[2] ForestFirst is the new name for the Saskatchewan Forest Centre, located in Prince Albert, Saskatchewan.
[3] http://www.forestfirst.ca.

*essential technical information and advice*." ForestFirst has assisted numerous (mostly) private land owners in the establishment of SRIC hybrid poplar crops.

Table 6 - Approximate area of hybrid poplar short-rotation-intensive-culture (SRIC) crops in Canada

| | SRIC crops | | | |
|---|---|---|---|---|
| | Reported in 2004 for 2000-2003 | Planted 2004-2007 | Total crops to and incl. 2007 | Planted 2008 |
| | Hectares | Hectares | Hectares | Hectares |
| Kruger Products Ltd. - British Columbia (*) | 1,000 | 70 | 1,070 | 14 |
| Catalyst Paper Corp. - British Columbia (**) | 1,317 | 0 | 200 | 0 |
| Alberta-Pacific Forest Ind. Inc. - Alberta (***) | 700 | 4,940 | 5,640 | 1,140 |
| Ainsworth Engineered Canada LP - Alberta | 0 | 215 | 215 | 250 |
| ForestFirst – Saskatchewan (+) | Unknown | Unknown | 300 | Unknown |
| Domtar Inc. – Ontario (++) | 2,000 | 0 | unknown | 0 |
| MRNF – Quebec (+++) | 150 | 200 | 350 | 0 |
| **Total** | **5,167** | **5,425** | **7,775** | **1,404** |

(*) Total reported in 2004 for the period 2000-2003 is an estimate.

(**) Estimated remainder of SRIC crops

(***)The reported hectares in the 2004 report (2,617 ha) does not correspond with the corrected hectares of 700 ha.

(+) ForestFirst facilitates establishment of SRIC hybrid poplar crops.

(++) Domtar Inc. in Ontario suspended its hybrid poplar program.

(+++) In the 2004 report hectares reported under SRIC should have been reported under Forest Plantations. The SRIC levels in the table are estimates from the «ministère des Ressources naturelles et de la Faune» (MRNF - Quebec).

Source: Personal communication with companies and the «ministère des Ressources naturelles et de la Faune» (MRNF – Quebec) in 2007.

### *6.4.2.2.1 Site preparation*

Site preparation usually includes use of registered herbicides, followed by intensive disking and cultivating of the soil. The next phase is the layout and preparation of plant rows prior to planting. Banding or direct-placing fertilizer at the bottom of the plant rows or planting locations may be integrated during this process.

Due to the continuing unavailability of labelled pre-emergent herbicides in Canada for SRIC poplar crops, no additional preventative weed control can be carried out. This has placed SRIC poplar crop farmers at a distinct disadvantage compared with colleagues in the US. A properly executed site preparation phase is critical to the eventual success of subsequent weed control in the crop tending phase.

Where the farm field size and shape is favourable, crop rows can be laid out in a perfect grid, using advanced global positioning (GPS) technology. Alberta-Pacific Forest

Industries Inc. (Al-Pac) has been using this technology successfully; crop plant locations are laid out in a 3 × 3 m square grid, using a GPS-steered tractor. This grid system enables cultivation in two directions (at ninety degrees), significantly increasing weed control options in the absence of suitable herbicides[1].

For second rotation SRIC hybrid poplar crops in British Columbia, Kruger Products Limited has opted to use a small hydraulic excavator to create individual planting spots. The company plants at a low crop density that varies from 280 to 450 stems per hectare. This method is cost-effective and avoids having to clear the stumps from the previous crop[2]. The main disadvantage is the inability to conduct mechanical weed control using farm tractors and cultivating equipment.

#### *6.4.2.2.2 Planting*

Depending on the region, the availability of stock and suitable clones, either a dormant unrooted cutting, bareroot stock or container-grown stock is planted in a systematic pattern on properly prepared farmland.

In the Prairie Region rooted stock is preferred due to dry soil conditions at planting time. Bareroot stock is preferred over container-grown stock due to lower costs and a higher proportion of coarse roots. There are still challenges in the production of good bareroot stock; however, this is steadily improving.

In Quebec the preferred stock type is a steckling, which is a rooted whip or set of 1.2 – 1.8 m in length. This stock type is particularly useful where weed control is not feasible, such as in forest plantations.

Unrooted, dormant cuttings are typically 30 to 90 cm long and are used in British Columbia. The increase in cutting length to 90 cm is a fairly recent development adopted by Kruger Products Limited and is particularly useful in situations where complete site preparation is not possible (e.g. on second rotation crops on farmland) and weed control cannot be complete.

#### *6.4.2.2.3 Crop Tending*

##### 6.4.2.2.3.1 Weed control

Following planting, control of competing weeds is the most critical treatment during the growing season. The stage is set for successful weed control during the site preparation phase. Poplar farmers rely on integrated weed control strategies, using a combination of mechanical and chemical means. In Canada, SRIC poplar crop farmers are at a distinct disadvantage compared with their US counterparts, as they do not have access to certain effective pre- and post-emergent herbicides. This issue is being addressed by the Pesticide Working Group (PWG) of the Poplar Council of Canada (see 6.4.2.2.5).

[1] Al Bertschi – personal communication.
[2] Dan Carson – personal communication.

#### 6.4.2.2.3.2 Fertilization

Research trials completed by MacMillan Bloedel Limited[1] – MB Poplar Farms Division (PFD) in 1997-1998 in southwest British Columbia, concluded that fertilization at time of planting with a mixture of N and P (mono-ammonium phosphate, or MAP @ 11-52-0), either placed or banded at the bottom of the plant rows, significantly increased early growth. Kruger Products Limited routinely uses a 'corn starter' fertilizer (NPK @ 9-40-4, plus minor elements) at root depth shortly after planting, and sometimes also at the start of the second growing season. This method is very successful[2].

Domtar in Windsor, Quebec, has also been using a fertilizer at time of planting for its forest plantations. The company places a chemical fertilizer near the rootzone with a planting shovel and has tried various fertilizer formulations[3].

Early (and mid-rotation) fertilization was standard practice for MB Poplar Farms Division (PFD) on SRIC hybrid poplar plantation crops on Vancouver Island – southwest British Columbia. The treatment worked best when both N and P were applied at the start of the third growing season, rather than just N. The company soon integrated fertilization at time of planting with MAP, followed by an application of urea fertilizer (45-0-0) at the start of the third growing season. The plan was to follow this with a mid-rotation urea fertilization[4]. Kruger Products Limited is considering following this practice in its SRIC hybrid poplar crops on leased farmland in southwestern British Columbia.

In the Prairie Provinces research trials were done to determine the need for fertilization at time of planting; however, results have been inconclusive and the practice has not (yet) been adopted in operational SRIC crops.

Research trials done in the Abitibi-Témiscamingue region of western Quebec showed a good first year response to fertilization at time of planting on heavy clay soils[5].

### *6.4.2.2.4 Yield, Crop Density and Rotation Length*

Crop (stand) density of SRIC hybrid poplar crops depends on the end product. Most crops to date are intended to produce pulp fibre; however, one company has started planting SRIC hybrid poplar for the production of OSB feedstock. Pulp crops are planted at fairly high densities, usually around 1,111 stems per hectare (Table 7). Poplar growers make allowances for a percentage of crop mortality to arrive at the right number of stems per hectare at harvest.

In British Columbia, Kruger Products Limited requires a larger piece size for its conversion facility, hence the lower stand densities.

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[1] MacMillan Bloedel Limited does not exist any more. The successor company owning the poplar farms is Catalyst Paper Corporation.
[2] Dan Carson – personal communication and personal observation.
[3] Éric Lapointe – personal communication.
[4] Personal information.
[5] Toma Guillemette – personal communication – MSc thesis.

Table 7 - Yield, crop Density and rotation length - Short-rotation-intensive-culture (SRIC) crops

| | Mean Annual Increment – MAI $m^3\ ha^{-1}\ yr^{-1}$ | Crop Density stems per ha (spha) | Rotation Length Year | Comments |
|---|---|---|---|---|
| Kruger Products Ltd. - British Columbia | 25 | 550 | 15 | Pulp wood |
| Alberta-Pacific Forest Ind. Inc. -.Alberta (*) | 16-18 | 1,111 | 18 | Pulp wood |
| Ainsworth Engineered Canada LP - Alberta(**) | Unknown | 816 | Unknown | OSB feedstock |

(*) These values are for hybrid poplar.
(**) Ainsworth recently decided to adopt a 3.5x3.5 m crop spacing for a crop density of 816 stems per hectare.
Source: Personal communication with companies in 2008

In the Prairie Provinces, Alberta-Pacific Forest Industries Inc. (Al-Pac) in Alberta plants 1,111 stems per hectare and makes an allowance for approximately 15% mortality during establishment[1]. Al-Pac's farm manager aims at a uniform stem size with a diameter range that will fit certain harvest equipment. Al-Pac is also planning to deploy its hybrid aspen, once selections have been made and confirmed.

Ainsworth Engineered Canada LP in Alberta is a recent newcomer to the field of SRIC hybrid poplar crops. The company started planting at 1,111 stems per hectare at 3 × 3 m crop spacing. They recently changed this to 3.5 × 3.5 m crop spacing or 816 stems per hectare and based this on a crop density report[2] commissioned by ForestFirst in Prince Albert, Saskatchewan[3].

### *6.4.2.2.5 Pesticides*

*This section on pesticides was updated on 8 December 2008 (see Appendix XI - Update 6.4.2.2.5).*

The Poplar Council of Canada (PCC) originally established the Pesticide Working Group (PWG) with the objective of expanding the range of available pesticides for use in SRIC (hybrid) poplar crops, including aspen and their hybrids. The mandate now also includes willow. The PWG has been successfully promoting SRIC (hybrid) poplar and SRIC willow crops on farmland as agronomic crops[4]. The goal is to apply for 'User Requested Minor Use Label Expansion' (URMULE) applications to the Pest Management Regulatory Agency (PMRA)[5] of Health Canada, to obtain labelling for useful pesticides.

[1] Al Bertschi – personal communication.
[2] Crop Density for Hybrid Poplar in the Prairie Provinces - authored by Cees van Oosten – SilviConsult Woody Crops Technology Inc.; http://www.saskforestcentre.ca/uploaded/200501_-_Crop_Density_for_Hybrid_Poplar.pdf.
[3] Fred Radersma – personal communication.
[4] Personal information.
[5] PMRA is part of Health Canada. PMRA regulates the registration and use of pesticides in Canada.

Currently few pesticides are registered for use in an SRIC poplar or willow crop (Appendices VII-A, Table A-1 and VII-B, Table B-2).

The PWG is working on several URMULE applications, primarily for much needed pre-emergent herbicides (Appendix VII-B, Table B-3). The URMULE for Goal 2XL (a.i.[1] oxyfluorfen) was submitted in March 2007 and is expected to be labelled early 2009. Trials for the URMULE for the new herbicide Chateau (a.i. flumioxazin) were established in the spring of 2008; results are to be submitted to the PMRA late 2008. The PWG also submitted an URMULE to obtain expanded labelling for the herbicide Lorox L (a.i. linuron) as a pre-emergent for both SRIC (hybrid) poplar and SRIC willow crops (Appendix VII-B, Table B-1); this product was already approved for use as a post-emergent on SRIC poplar in western Canada only.

Three Senator fungicide products are labelled for use in aspen and poplar to control *Septoria* leaf spot and *Marssonina* leaf spot (Appendix VII-B, Table B-2). There is no product labelled yet for the control of *Melampsora* leaf rust species in Canada. Trials are currently ongoing with the fungicide Folicur 432F (a.i. tebuconazole) to control the leaf rust species for both *Populus* and *Salix* species; results will be submitted to the PMRA at the end of 2008. The Folicur 432F URMULE application includes a request for a label to control *Septoria* leaf spot and *Marssonina* leaf spot species in *Populus* species, including their hybrids.

The PWG also intends to re-visit several of these pesticides in order to obtain labeling for SRIC willow crops.

### 6.4.3 WILLOW – SRIC CROPS

There is great potential for significant SRIC willow crop production in Canada. Most willow production is still in an experimental phase and the majority of applications fall under an environmental umbrella (see 6.7.2). In essence the cultivation approach for SRIC willow does not differ much from the cultivation of an SRIC hybrid poplar crop, in particular poplar stoolbed production systems.

The Canadian Wood Fibre Centre of Environment Canada, Canadian Forest Service in Alberta has been conducting willow trials across Canada[2]. The purpose of these trials is

- to test clones, originating from the University of Toronto willow program under the late Dr. Louis Zsuffa and from the State University of New York (SUNY) in the USA, for suitability on a range of soils and in various climates;
- to determine yield of biomass production;
- to promote and demonstrate the SRIC willow biomass concept to farmers and landowners; and
- to conduct herbicide screening trials.

[1] a.i. = active ingredient.
[2] Richard Krygier – personal communication.

In the short term, the main purpose of the biomass crops would be to provide feedstock for the production of small to medium heating plants and possibly to augment feed stock for power plants run on wood fibre. For the longer term, feedstock will be produced for large-scale gasification plants for heat and power production and possibly for the production of ethanol.

The University of Saskatchewan in Saskatoon[1], Saskatchewan, obtained funding for a three-year period in 2007 to conduct research trials with willow. Willow trials were planted at four locations in Saskatchewan with the objective of testing the SRIC willow crop biomass production concept and to conduct clonal testing to determine which clones would be suitable under Saskatchewan conditions. Clonal material was obtained through the Canadian Wood Fibre Centre, Canadian Forest Service in Alberta. The University also has a cooperative trial with the State University of New York (SUNY) to test several of their willow clones.

To date lack of cold hardiness of several clones has become evident and emphasizes the need to locate material that can handle the climatic conditions of Saskatchewan. Eventually well-adapted clones are expected to be produced by the Prairie Farm Rehabilitation Administration, Shelterbelt Centre (PFRA) of Agriculture and Agri-Food Canada (AAFC) in Saskatchewan (see 6.3.1.2). Funding for the University of Saskatchewan runs out in 2009; no decision has been made on the future of the trials.

In Quebec much of the experimental work is conducted through the Montreal Botanical Garden, «Institut de recherche en biologie végétale» (IRBV)[2]. The IRBV established approximately 110 hectares of SRIC willow crop trials to investigate the feasibility of large scale SRIC willow crops for biomass production in eastern Canada. The program relies on extensive cooperation with landowners.

Purpose of the experimental work is

a) to test clonal material (Table 8);
b) to determine the nutritional requirements of willow; and
c) to establish site (soil)/species interaction.

Table 8 – Salix clones under test by the Montreal Botanical Garden

| Clone name | Species |
|---|---|
| SV1 | *Salix dasyclados* |
| S301 | *Salix interior ×eriocephala* |
| S25 | *Salix eriocephala* |
| S365 | *Salix discolor* |
| SX61 | *Salix sachalinensis* |
| SX64 | *Salix miyabeana* |
| SX67 | *Salix miyabeana* |
| S546 | *Salix eriocephala* |
| S625 | *Salix eriocephala ×interior* |
| SVQ | *Salix viminalis* |

[1] Ken Van Rees – personal communication.
[2] http://www.irbv.umontreal.ca/. Michel Labrecque – personal communication.

## 6.5 FOREST PROTECTION

### 6.5.1 DISEASES & PESTS

Table 9 lists the main disease and pest problems affecting hybrid poplar forest plantations and SRIC hybrid poplar crops in Canada. This list does not include diseases and pests in natural stands.

Table 9 - New developments in *Populus* and *Salix* diseases and pests in Canada

| | Name | Common name | New Area or Area of Persistent Problem |
|---|---|---|---|
| Diseases | *Septoria musiva* | Septoria stem canker | Quebec, Prairie region and British Columbia |
| | *Melampsora ×columbiana* | (Hybrid) Leaf rust | British Columbia |
| | *Melampsora larici-populina* | Eurasian Rust | Quebec |
| | *Melampsora* (unidentified) | Leaf rust spp. | Quebec |
| Insects | *Cryptorhynchus lapathi* | Poplar willow borers | Saskatchewan (southern) and coastal British Columbia |
| | *Hamamelistes spinosus* | Witch hazel gall aphids | Alberta |
| | *Lygus lineolaris* | Tarnished plant bug | Quebec (southern Quebec) - nursery |
| | *Popilla japonica* | Japanese beetle | Quebec (southern Quebec) - nursery |
| | Unknown spp. | Aphid spp. | Quebec (southern Quebec) - nursery |

#### 6.5.1.1 Septoria musiva

There is a serious concern with the spread of *Septoria musiva* stem canker in Quebec to areas previously unaffected. It is unclear if a changing climate is responsible for this development[1].

In 2006 *Septoria musiva* stem canker was positively identified in southwestern and south coastal British Columbia (Fraser Valley and one coastal river drainage about 100-200 km north of Vancouver). This new disease in British Columbia has affected several SRIC hybrid poplar crops as well as stoolbeds at one nursery in the eastern Fraser Valley. This is the first documented presence of the disease west of the Rocky Mountains in North America. *Septoria musiva* is thought to have been present for at least 11 years[2]). A survey in 2007 identified several 'epicentres' and determined that most hybrids with a *Populus maximowiczii* parent are at risk; however, there were notable exceptions (clone NM6, *Populus nigra* × *P. maximowiczii* and clone 265-28, *P. trichocarpa* × *P. maximowiczii*). The survey further determined that many of the *Populus trichocarpa* × *P. deltoides* hybrids are affected; however, it also concluded that a substantial number of these hybrids remained symptom free after four years. There was no evidence of the

[1] Pierre Périnet – personal communication.
[2] Wrap-up Report "11 December 2007 – *Septoria musiva* survey". Internal Ministry of Forest and Range report authored by Cees van Oosten – SilviConsult Woody Crops Technology Inc.

disease affecting native black cottonwood, *Populus trichocarpa*, at this time[1]. Further work is planned in 2008 and beyond.

In retrospect, the 2004 report[2] erroneously attributed these cankers to the 'blackstem' disease *Phomopsis oblonga*. In the 2006 survey that led to the positive identification numerous cankers were infected by the secondary pathogen *Cytospora chrysosperma*, also a 'blackstem' disease. This disease easily colonizes cankers caused by *Septoria musiva* and displaces any signs of it[3].

*Septoria musiva* stem canker infections are on the rise in the Prairie region as a result of a rapidly increasing number of SRIC hybrid poplar crops. One of the issues there is the heavy reliance on one clone ('Walker', a three-way cross between a *Populus. nigra* × *P. laurifolia* female hybrid and a *P. deltoides* male. 'Walker' has been proven to be highly susceptible to the disease.

### 6.5.1.2 Melampsora rust species

Another significant development is the spread of *Melampsora larici-populina* in at least one nursery and several stands of hybrid poplar in Quebec[4].

After a temporary absence, the hybrid rust *Melampsora* ×*columbiana*, a hybrid rust between *M. occidentalis* and *M. medusae*, is continuing its onslaught in southwestern coastal British Columbia. It is primarily affecting *Populus trichocarpa* × *P. deltoides hybrids*.

The area of SRIC willow crops is still small and most crops are still experimental in Canada. Disease and insect problems have yet to get established; however, one willow farmer in Quebec reports that *Melampsora* leaf rust (exact species unknown) has become a problem[5].

### 6.5.1.3 Fungicides

Kruger Products Limited applied for and obtained an emergency label for the product Folicur 423F (a.i. tebuconazole), a common agricultural fungicide, to control *Septoria* leaf spot (caused by *Septoria populicola* and *S. musiva*) and *Melampsora* leaf rust species (especially *M.* ×*columbiana*) at its nursery. The latter seriously affected nursery stock in 2007 and is thought to have weakened the stoolbeds, making them more susceptible to stem canker infections by *Septoria musiva*. Folicur 432F applications were alternated with applications of the labelled fungicide Senator (a.i. thiophanate-methyl) in 2008 with excellent results. The stoolbeds were free of leaf diseases well into the fall of 2008[6]. It

[1] Personal observations.
[2] Canadian Report to the 22nd Session, Santiago, Chile - International Poplar Commission for the Period 2000-2003.
[3] Brenda Callan – personal communication.
[4] Pierre Périnet – personal communication.
[5] Francis Allard – personal communication).
[6] Dan Carson – personal communication.

is too early to determine if the applications of these fungicides will control the spread of *Septoria* musiva stem cankers. The nursery reported an excellent 2008 crop.

Trials with the fungicide Folicur 432F are being conducted at locations in British Columbia, Saskatchewan and Quebec; results will be known late 2008.

#### 6.5.1.4 Insects

Few serious insect problems were reported in SRIC (hybrid) poplar and willow crops.

Poplar willow borers (*Cryptorhynchus lapathi*) are becoming a problem in southern Saskatchewan[1] and southwestern coastal British Columbia[2]. The borers in British Columbia affected a crop of eight-year old SRIC hybrid poplars, which turned out be an inadvertent mix of three clones of *Populus trichocarpa* × *P. deltoides*. One of these clones was very susceptible and was killed by the borer attack; the crop was harvested prematurely in 2007 to recover the wood.

Alberta-Pacific Forest Industries Inc. reported that several young SRIC hybrid poplar crops in Alberta were affected by Witch hazel gall aphids (*Hamamelistes spinosus*); however, damage appears to be limited[3]. The aphids were also present in poplar nurseries in Alberta.

Quebec reported a problem with Japanese beetle (*Popilla japonica*) in one of their poplar nurseries[4]. This insect is not normally associated with poplar. Other nursery problems were reported with the tarnished plant bug (*Lygus lineolaris*) and aphid species.

## *6.6 HARVESTING AND UTILIZATION*

In cooperation with Agriculture and Agri-Food Canada (AAFC) and Natural Resources Canada (NRCan), researchers at the University of Laval in Quebec developed a prototype willow harvester, based on a 'cutter/shredder/baler' concept, named the 'Willow Harvester'. Such balers are in use for hay production and produce round bales. The researchers used existing technology of a New Holland hay baler, made modifications and demonstrated the feasibility of harvesting willow coppice (and other low-growing brush species). The concept is not limited by row layout and can harvest randomly located stems. Further development has come to a halt and the future of the concept is unclear[5].

### 6.6.1 PULP & PAPER

The value of naturally growing native aspen (*Populus tremuloides*) in pulp and paper manufacturing is well recognized in North America. Currently aspen is used by several

[1] Larry White – personal communication.
[2] Personal observation.
[3] Al Bertschi – personal communication.
[4] Roger Touchette – personal communication.
[5] Bill Schroeder – personal communication.

large pulp mills in Alberta and pulp & paper mills in Quebec[1]. Most pulp mills accept a certain percentage of poplar (balsam poplar and cottonwood) in their wood supply. Aspen pulp is manufactured using the

- Kraft (chemical) process; or
- CTMP[2] process

Use of *Populus* species for pulping requires less bleaching chemicals in the Kraft process and less brightening chemicals in the CTMP process. The end products are many and include high quality paper, for use in photographic grades and high gloss magazines.

One mill in British Columbia makes groundwood pulp for its tissue business[3], using black cottonwood (*Populus trichocarpa*), balsam poplar (*P. balsamifera*), as well as hybrid poplar from its forestlands and SRIC hybrid poplar crops from leased farmlands.

Plantation or SRIC (hybrid) aspen and hybrid poplar prove to be very suitable replacements for the aspen stock currently used. FPInnovations[4] – Paprican (Pulp and Paper Research Institute of Canada) has carried out research into the use of SRIC hybrid poplar fibre in the manufacturing of pulp and paper. The results are very encouraging and the fibre offers similar advantages to that of naturally growing native aspen.

### 6.6.2 SOLID WOOD & COMPOSITE WOOD

There has been a growing interest in use of naturally growing native aspen (*Populus tremuloides*) for higher-value lumber products and several small entrepreneurs have been experimenting with lumber recovery, drying and manufacturing. The challenges will be access to a sustainable supply of high-grade material and development of stable markets.

The previous National Reports to the IPC[5] reported on the developmental work with hybrid poplar for products ranging from tongue & groove wall paneling, window and wall mouldings, to furniture and decorative boxes. FPInnovations - Forintek[6] was involved in much of the wood-technical assessments.

Native aspen is the preferred stock for the manufacture of Oriented Strand Board (OSB) and TimberStrand® laminated strand lumber (LSL)[7]. OSB has largely displaced plywood as a building product used in sheeting in North American construction; TimberStrand® is used for structural (indoor) use.

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[1] Daishowa-Marubeni International Ltd., Alberta-Pacific Forest Industries Inc. and Millar Western Forest Products Ltd. in Alberta; Catalyst Paper Corporation in British Columbia; Domtar Inc. in Quebec.

[2] CTMP = Chemi-thermo-mechanical pulp.

[3] Kruger Products Limited.

[4] FPInnovations "brings together FERIC, Forintek, Paprican, and the Canadian Wood Fibre Centre of Natural Resources Canada, to create the world's largest private, not-for-profit forest research institute". http://www.fpinnovations.ca/index.htm.

[5] The Canadian Reports to the 21st and 22nd Sessions of the International Poplar Commission in Seattle (Wa), USA and Santiago, Chile respectively.

[6] http://www.forintek.ca/

[7] http://www.weyerhaeuser.com/Businesses/WoodProducts/TimberStrand. Timberstrand was a product innovation by MacMillan Bloedel Limited of Vancouver, B.C., Canada. MacMillan Bloedel was obtained by Weyerhaeuser in 1999.

As in the pulp and paper business, there has been increased interest in use of SRIC hybrid poplar wood for composite wood products. Much of this development work was carried out by FPInnovations - Forintek. Several products were manufactured from SRIC hybrid poplar and the test results were very encouraging. Products made and tested include OSB, Laminated Veneer Lumber (LVL), Medium Density Fibreboard (MDF) and plywood. High quality aspen and poplar veneers can be covered with expensive veneers for cabinetry.

The challenge will be developing a sustainable supply of high quality wood and a subsequent stable market.

## *6.7 ENVIRONMENTAL USES*

### 6.7.1 POPLAR

Hybrid poplar has promising environmental uses in phytoremediation, riparian restoration, carbon sequestration, renewable energy etc. This report will briefly touch on carbon sequestration under 'Greenhouse Gases and Poplar' (see 7).

Some ongoing projects in phytoremediation in British Columbia have involved Kruger Products Limited's SRIC hybrid poplar crops in the Fraser Valley in southwestern British Columbia[1]. Several SRIC crops received municipal biosolids; however, this program is now complete. A hog farmer in the Fraser Valley established an SRIC hybrid poplar crop on his land under Kruger Products' 'Private Growers Program'. The farm owner uses the SRIC crop for liquid manure management. Since this use of manure is still experimental and exploratory, there is no information yet on variables such as maximum uptake rates and how these rates may vary as the growing season progresses, in relation to amounts and timing of applications. The site grew corn before it was converted to poplar. Under BC Assessment regulations, intensively managed hybrid poplar is considered primary agricultural production (see 4.1.1), so there were no issues of land tax disincentives for the farmer when switching to an SRIC hybrid poplar crop.

Other ongoing projects in British Columbia with poplar involve the reclamation of the tailings of mineral mine sites and the reclamation of sites mined by the aggregate industry (e.g. gravel for concrete manufacturing), frequently with the addition of municipal biosolids[2].

There is substantial interest in Saskatchewan to use both poplar and willow in management of municipal effluents and several proposals are pending to establish a network of such projects in several Saskatchewan municipalities[3], subject to funding. These proposals are being developed through the Saskatchewan Research Council and ForestFirst.

[1] Dan Carson – personal communication.
[2] Mike Van Ham – personal communication – 2004.
[3] Larry White, Monique Wismer – personal communication.

Domtar Inc. in Windsor, Quebec, is starting a program of fertilization of forest plantations with residual material from the pulp mill (such as mill sludge, ash, lime mud) to reduce the need for landfill[1].

There are numerous opportunities like this throughout Canada, where the main focus is the safe land application and utilization of various municipal and industrial (bio-)wastes.

### 6.7.2 WILLOW

The use of willow has great potential in Canada for both environmental and biomass production reasons.

In Alberta the Canadian Wood Fibre Centre[2] within the Canadian Forest Service (CFS) of Natural Resources Canada has established 13 willow trials across Canada. The purpose of these trials was discussed in section 6.4.3. Besides the production of biomass as feedstock for various end uses, willow has great potential in environmental applications such as in the energy substitution of fossil fuels and in phytoremediation work. The latter has especially great potential in solving many municipal effluent disposal issues. One such project with willow was established at the town of Whitecourt, Alberta, and has been serving as a powerful demonstration project. New initiatives with other municipalities are being developed based on the Whitecourt example[3].

In Saskatchewan a similar project with willow and poplar is being planned, as was reported previously (see 6.7.1). The Prairie Farm Rehabilitation Administration, Shelterbelt Centre (PFRA) of Agriculture and Agri-Food Canada (AAFC) in Saskatchewan has established a large common garden study of native willow species from across Canada. This collection will be the basis for a new willow breeding and selection project (see 6.3.1.2)

The Montreal Botanical Garden, «Institut de recherche en biologie végétale» (IRBV)[4] has a strong background in research on SRIC willow crop production and use of willow in environmental applications. The IRBV is a member of the 'Salix Consortium[5]', formed in 1994; this is an association of corporations with industrial, government, farming, and research organizations. The IRBV is the only Canadian partner.

#### 6.7.2.1 International Poplar Commission meeting Montreal – 2007

The Montreal Botanical Garden organized and hosted the International Poplar Commission (IPC), Working Party on Environmental Applications of Poplar and Willow[6]. The meeting was held in June 2007 in Montreal, Quebec, with field visits in

[1] Éric Lapointe – personal communication.
[2] http://cfs.nrcan.gc.ca/subsite/cwfc/home http://cfs.nrcan.gc.ca/subsite/cwfc/home; Richard Krygier – personal communication.
[3] Richard Krygier – personal communication.
[4] http://www.irbv.umontreal.ca/; Michel Labrecque – personal communication.
[5] http://www1.eere.energy.gov/biomass/pdfs/consortium.pdf.
[6] http://www.fao.org/forestry/26214/en/.

the Montreal area and Syracuse, New York State (USA). The meeting drew international participation from Europe, Australia and North America.

The field trips highlighted some of the innovative uses of willow in environmental applications, such as an ecological sound barrier in the form of a 'living wall' of tightly planted willow whips. These living walls are established along major roads near Montreal and form cost-effective noise barriers at a fraction of the cost of conventional noise barriers. During the field trip to Syracuse, New York State, one project showed a novel way to combat stream and lake pollution originating from Solvay[1] waste beds. A dense willow canopy established on these waste beds acts as an evapotranspiration surface that not only intercepts precipitation for evaporation, but also has the ability to extract water from the soil, preventing it from entering the groundwater. Willow offers such potential as an evapotranspiration surface, which is a cheaper and environmentally more benign alternative to a geomembrane cap[2].

[1] The Solvay process or ammonia-soda process has been the major industrial process used in the production of soda ash (sodium carbonate). It produces highly basic waste products that were deposited in settling ponds, in this case near Syracuse, N.Y.

[2] Personal observation – reported in the Poplar Council of Canada Newsletter, Summer 2007.

# 7 GREENHOUSE GASES AND POPLAR

As a signatory to the Kyoto Agreement on the reduction of greenhouse gases (GHG), the Government of Canada is committed to implement policies to reduce the production of GHG. One avenue is to focus on establishing new forests on previously non-forested lands – primarily agricultural lands.

## *7.1 FOREST 2020*

Forest 2020 was an initiative started in 2003 by the Canadian Government to demonstrate the feasibility of establishing a network of fast-growing plantations. The program was wrapped up in early 2006.

The use fast-growing tree plantations is considered part of the strategy to deal with the potential impacts of climate change. Natural Resources Canada, Canadian Forest Service (CFS) initiated Forest 2020, which was a plantation demonstration and assessment project with a focus on

- establishing demonstrations of fast-growing tree plantations across Canada to mitigate greenhouse gas emissions and generate more wood fibre; and
- exploring investment mechanisms to attract funds to establish plantations in the future.

One of the purposes of this initiative was to encourage investment in the establishment of fast-growing plantations by private investors such as green investment funds, ethical funds, pension funds, and large industrial emitters.

Under the Forest 2020 program approximately 6,000 hectares of SRIC woody crop demonstration sites were established on private lands. Although many of these crops were successfully established, several crops suffered from a lack of continuous weed control[1] and general maintenance. The financial analysis "*indicated that while fast growing forest plantations can provide a range of timber supply and carbon benefits, market mechanisms alone are generally not high enough to drive significant amounts of private investment across the country. On a national scale, given the expected low private investor returns and uncertainty over future carbon prices, additional public expenditures would be needed to attract significant private investment in fast growing plantations*"[2].

## *7.2 CARBON CREDITS*

The Kyoto protocol seeks to limit greenhouse gases (GHG) by a country-specific percentage below 1990 levels in the first commitment period 2008-2012. There still is little clarity in carbon credit eligibility for projects, particularly for 'forest-carbon'

[1] Personal observations.
[2] http://cfs.nrcan.gc.ca/subsite/afforestation/forest2020pda.

projects. The Forest Products Association of Canada established a Forest Carbon Committee that is currently involved in a review of forest-carbon protocols[1].

### 7.2.1 ALBERTA

Since establishing a small SRIC hybrid poplar pilot project in 1995, Alberta-Pacific Forest Industries Inc. (Al-Pac) in Alberta has embarked on large-scale SRIC hybrid poplar crop establishment, which will eventually grow to 25,000 hectares[2]. The company successfully proposed to Environment Canada the sale of its "*verified GHG* [greenhouse gas] *emission reductions*" from SRIC hybrid poplar crops, established between 2004 and 2007, to PERRL[3]. Environment Canada now owns these verified GHG emission reductions. PERRL stands for 'Pilot Emission Removals, Reductions and Learnings Initiative'.

PERRL no longer accepts new applications and the program will be wrapped up in 2008. It could be considered the pre-cursor to formal carbon trading, which is scheduled to commence in 2008[4].

In September 2007 Alberta Environment of the Alberta Government produced a protocol for afforestation projects[5] to assist in the process of defining and quantifying the opportunity for generating carbon offsets that arise from "*carbon sequestration from planting trees on land not traditionally forested such as agricultural land, urban land, agro-forestry operations and perhaps rehabilitation of industrial lands*".

### 7.2.2 SASKATCHEWAN

There appears to be significant interest by at least one private investor in Saskatchewan to establish SRIC hybrid poplar crops on farmland on a large scale with the main objective to create carbon offsets (carbon credits). This investor planted a 20 hectare pilot crop in 2008 and intends to expand his crop area significantly over the next several years[6].

[1] Ken Plourde – personal communication.
[2] Chuck Kaiser – personal communication – 2004.
[3] http://www.ec.gc.ca/PERRL/home_e.html
[4] Werner Kurz – personal communication 2004.
[5] 'Quantification Protocol for Afforestation Projects' - ISBN: 978-0-7785-7214-5 (Printed) or ISBN: 978-0-7785-7215-2 (On-line).
[6] Larry White – personal communication.

# 8 POPLAR GENOME PROJECT

*This section on the poplar genome project was updated on 8 December 2008 (see Appendix XI - Update 8).*

One of the highlights in the period 2004-1007 was the completion and publication of the complete genome sequence for black cottonwood (*Populus trichocarpa*) [1] in 2006 by an international group of scientists, including several Canadian scientists supported by GenomeCanada [2]. This was a collaborative effort by the Joint Genome Institute (US Department of Energy), Oak Ridge National Laboratory in Tennessee, USA, the Treenomix program at the University of British Columbia (UBC), Genome Sciences Centre (Genome British Columbia) in Vancouver, British Columbia, Canada, the Swedish Populus Genome Project located in Umeå, Sweden, and the Bioinformatics and Evolutionary Genomics Division, University of Ghent in Ghent, Belgium[3].

In Canada the *Populus* resource represents an enormous source of (potential) wealth and many in the poplar breeding and nursery community have high hopes that advances in *Populus* genomics will eventually lead to opportunities to develop techniques to assist in the selection and breeding of *Populus* clones with desirable traits. In April 2005 the Poplar Council of Canada hosted a 'Genomics to Production' workshop in Edmonton, Alberta to bring together the genome research community and the poplar breeding and nursery community to establish lines of communications that would benefit both. Although progress was made towards better communication, further progress stopped when funding for continued poplar genomics work did not materialize.

There are two main research groups studying tree genomics in Canada, Treenomix[4] at the University of British Columbia and Arborea[5] at Laval University in Quebec City, Quebec, Canada. Treenomix concentrates on conifer forest health, and spruce (*Picea*) is its main interest; there is scant mention of poplar. Arborea concentrates on identifying "genes that govern naturally occurring phenotypic variation of commercially valuable traits in breeding populations of white spruce trees (*Picea glauca*)."

From an operational viewpoint, the main emphasis of *Populus* tree selection and breeding is to create useful clones that realize significant heterosis (hybrid vigour), are very resistant or tolerant to diseases and pests, and are able to successfully withstand the various rigours of the Canadian climate. Other potentially important criteria, such as improved wood quality to meet specific demands for processing, are at this time still secondary considerations.

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[1] Tuskan, G. A. et al; The Genome of Black Cottonwood, *Populus trichocarpa* (Torr. & Gray); Science 15 September 2006: Vol. 313. no. 5793, pp. 1596 - 1604; DOI: 10.1126/science.1128691. A full reference can be found in Appendix X, 'Literature Listing' (item 315).
[2] http://www.genomecanada.ca/en/.
[3] http://www.poplar.ca/pdf/g2ppaper.pdf.
[4] http://www.treenomix.ca/Home.aspx.
[5] http://www.arborea.ulaval.ca/en/.

# 9 GENERAL INFORMATION

## *9.1 POPLAR COUNCIL OF CANADA/CONSEIL DU PEUPLIER DU CANADA*

The following information was prepared by Jim Richardson, Technical Director, PCC on August 27, 2008.

### 9.1.1 ADMINISTRATION AND OPERATION OF THE NATIONAL POPLAR COMMISSION

The Poplar Council of Canada (PCC) functions as the National Poplar Commission of Canada. PCC is recognized by the Government of Canada as representing the country nationally and internationally in all matters dealing with growth, production and utilization of poplars and willows.

PCC is an incorporated not-for-profit organization, with individual and corporate members. It was established in 1978. In 2008, the PCC had 43 individual paid-up members and 15 corporate members, as well as 3 libraries which currently receive the Council's newsletter. There has been a decline in membership in recent years reflecting the consolidation that is occurring as well as the economic difficulties in the Canadian forest industry sector.

#### 9.1.1.1 PCC Administration

PCC is run by an annually elected Executive Committee and Board of Directors. Its day-to-day affairs are managed by a part-time Executive Secretary based in the Council's Secretariat. Until her recent resignation, this position was filled by Lisa Bowker. Since 1999 the Secretariat has been housed in offices of the Canadian Forest Service, Natural Resources Canada in Edmonton, Alberta. Since 1997, PCC has retained the services of Jim Richardson as a part-time Technical Director to the Council, providing technical and scientific support. Jim is based in Ottawa, Ontario.

PCC contact information is as follows:

| | |
|---|---|
| Address: | Poplar Council of Canada<br>5320 - 122nd Street<br>Edmonton, Alberta<br>Canada T6H 3S5 |
| Phone: | +1 780 435-7282 |
| Fax: | +1 780 435-7356 |
| E-mail: | poplar@poplar.ca |
| Website: | http://www.poplar.ca |

The following individuals were elected to the Executive Committee at the Annual Business Meeting held in August 2008:

Executive Committee

| | | |
|---|---|---|
| Chair | J. Doornbos | Canadian Forest Service, Edmonton, Alberta |
| Past Chair | J. Richardson | Ottawa, Ontario |
| Vice-Chair West | C. van Oosten | SilviConsult Woody Crops Technology Inc., B.C. |
| Vice-Chair East | A. DesRochers | Univ. du Québec en Abitibi-Temiscamingue, Quebec |
| Secretary-Treasurer | B. Thomas | Genstat Consulting, Edmonton, Alberta |
| Executive Secretary | Vacant (ex officio) | Edmonton, Alberta |
| Technical Director | J. Richardson (ex officio) | Ottawa, Ontario |

Board of Directors

1. *Representatives*

| | | |
|---|---|---|
| Composition boards & veneers | M. Angelini | Structural Board Association, Toronto, Ontario |
| Pulp & paper, chemicals | B. Kokta | Université du Québec, Trois-Rivières, Québec |
| Wood products & Utilization | S. Mansfield | University of B.C., Vancouver, B.C. |
| Alberta | T. Gylander | Weyerhaeuser Canada, Edmonton, Alberta |
| Atlantic | O. Rajora | University of New Brunswick, Fredericton, N.B. |
| British Columbia | D. Carson | Kruger Products Ltd., Vancouver, B.C. |
| Ontario | J. Richardson | Poplar Council of Canada |
| Quebec | P. Périnet | Ministère des Ressources naturelles du Québec |
| Saskatchewan | W. Schroeder | PFRA Shelterbelt Centre, Indian Head, Sask. |
| Universities | D. Khasa | Université Laval, Québec |

2. *Working Groups*

| | | |
|---|---|---|
| Genetics and Breeding | B. Thomas | Genstat Consulting, Edmonton, Alberta |
| Pesticides | C. van Oosten | SilviConsult Woody Crops Technology Inc., B.C. |

## 9.1.2 PCC ACTIVITIES

The PCC holds annual meetings of its members. These meetings usually take the form of 1-2 days of technical sessions for presentation of papers and several days of field study tours. Efforts are made to hold the meetings in different parts of the country each year in

order to maximize participation. When opportunities arise, joint meetings are held with other related organizations.

In August 2005, the 27th Annual Meeting was held in Prince Albert, Saskatchewan, in conjunction with the Annual Meeting of the Canadian Institute of Forestry. The joint meeting, on the theme of 'Forestry rebellion: leading change', included 2½ days of technical sessions, of which a full day of concurrent sessions related to agroforestry, poplar farming and PCC national activities, and a full day of field visits. Following the joint meeting, PCC held a day-long strategic planning session to develop priorities. A short business meeting was also held.

In September 2006, the 28th Annual Meeting was held in Pasco, Washington, USA in conjunction with a meeting of the Short Rotation Woody Crops Operations Working Group of the US. The meeting was co-sponsored by the Poplar Council of the US, IUFRO Applied Temperate Short-Rotation Forestry Group and the Society of American Foresters Agroforestry Working Group. It included 2½ days of technical sessions, a full-day field tour of irrigated hybrid poplar plantations in the area, and a post-meeting field tour with a phytoremediation focus. A business meeting was also held.

In September 2007, the 29th Annual Meeting was held in Quebec City as part of the Quebec «Carrefour de la recherche forestière»'. Within that overall event which included 2 days of poplar- and willow-related technical sessions on the theme of 'Poplar culture: a collaborative effort from clone to mill', the PCC had a joint technical session with the IUFRO Larix Working Group. There were 2 days of field visits in the Lower St. Lawrence River region of Quebec with strong industrial interaction. A short business meeting was held.

In August 2008, the 30th Annual Meeting was held in Bloomington, Minnesota, USA in the context of a Short Rotation Crops International Conference organized by the US Department of Agriculture Forest Service and Agricultural Research Service, with a number of co-sponsors including the Poplar Council of the US and the Short Rotation Woody Crops Operations Working Group of the US. The theme of the conference was 'Biofuels, bioenergy and bioproducts from sustainable agricultural and forest crops' which was addressed over 2½ days of technical sessions and 2½ days of field visits to woody (mostly hybrid poplar) and herbaceous crops. Again a short business meeting was held.

In addition to annual meetings and field study tours, PCC undertakes a variety of communication-related activities. A newsletter is published twice a year for members, with articles of current interest related to poplar and willow, including information from PCC field study tours. The Council has endeavoured, with mixed success, to produce and disseminate annual reports on poplar and willow activities in different regions and sectors of the country. An Internet website is actively maintained (www.poplar.ca). The site has general information about the Council and its activities, news of upcoming and recent events, contents of back issues of the PCC Newsletter, the most recent annual meeting proceedings and provincial and sectoral reports, as well as links to other sites of

interest, including IPC. In a part of the website accessible only to members, contact information for all individual and corporate members is made available.

The Genetics and Breeding Working Group of PCC has successfully completed a major up-date and improvement of the Council's poplar and willow clone directory, previously available only in hard copy dating from 1986. The directory is now available in searchable electronic database format on the PCC website, where access is limited to members only. Related databases of public and private organizations involved in poplar breeding in Canada have been incorporated.

The Pesticide Working Group (formerly the Herbicide Working Group) is also very active, with a focus on expanding the number of approved agricultural herbicides and other pesticides available for use on poplars and recently also willows. In this effort, it is working, with the help of the Prairie Pesticide Minor Use Consortium (PPMUC), through the User Requested Minor Use Label Expansion (URMULE) process of the federal Pest Management Regulatory Agency (PMRA).

In April 2005, PCC hosted a significant 2-day workshop in Edmonton, Alberta, focusing on 'Genomics to Production'. The objective was to bring together scientists involved in exploring the poplar genome and traditional poplar breeders and growers in an effort to bridge the gap between the cultures of these two very different groups and to improve communication and collaboration. Some success was achieved and the proceedings of the event are available on the PCC website.

### 9.1.3 DIFFICULTIES ENCOUNTERED AND LESSONS LEARNED

PCC faces the type of problems encountered by most volunteer, non-profit organizations with minimal staff. It is a constant struggle to deliver a level of services sufficient to maintain membership interest and participation. These difficulties are exaggerated by the enormous geographical size and variety of the country, which makes for regional biases in participation in meetings and workshops.

However, PCC has found that the Internet provides a cheap and easy means of improving communication and distribution of information. Holding meetings and field study tours in different regions of the country and in conjunction with meetings of other related organizations also helps promote the exchange of information and experience.

Conscious of the limitations its financial means place on the activities it can pursue, PCC is keen to take advantage of opportunities that its national, non-government status, representing all stakeholders in the poplar and willow sector, offers to foster networking and collaboration. Current increasing interest in bioenergy, carbon sequestration and phytoremediation is likely to present such opportunities and enable the Council to continue to pursue its mission to 'promote the sound management and wise use of the [poplar and willow] resource for the benefit of all Canadians.'

# APPENDIX I

| Area (ha) by Province & Territory of forest stands where the predominant* genus is *Populus* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Area (ha) Hectares by Age Class** | | | | | | | | |
| Age class | 0 - 20 | 21 - 40 | 41 - 60 | 61 - 80 | 81 - 100 | 101 - 120 | 121+ | Other** | **Total** |
| Newfoundland & Labrador | 2,403 | 2,293 | 753 | 1,974 | 2,360 | 1,141 | 990 | 58 | **11,970** |
| Nova Scotia | 1,708 | 9,288 | 27,396 | 7,436 | 445 | 22 | - | 10,114 | **56,409** |
| Prince Edward Isl. | 1,087 | 7,303 | 6,169 | 2,903 | 650 | 110 | 24 | 7,025 | **25,271** |
| New Brunswick | 57,995 | 24,598 | 64,648 | 73,977 | 40,974 | 14,052 | 6,420 | 24,219 | **306,884** |
| Quebec | 143,130 | 491,626 | 1,025,953 | 623,755 | 133,158 | 9,373 | 828 | 9,142 | **2,436,966** |
| Ontario | 254,649 | 573,790 | 1,358,281 | 2,237,428 | 1,170,238 | 600,033 | 154,781 | - | **6,349,200** |
| Manitoba | 259,659 | 71,866 | 152,195 | 109,510 | 41,235 | 1,706 | 5 | 2,642,110 | **3,278,286** |
| Saskatchewan | 50,415 | 153,111 | 438,943 | 669,762 | 418,421 | 435,737 | 120,152 | 619,844 | **2,906,384** |
| Alberta | 394,410 | 2,400,240 | 2,181,232 | 1,554,626 | 1,254,119 | 519,904 | 135,335 | 26,574 | **8,466,440** |
| British Columbia | 151,612 | 523,376 | 815,525 | 815,753 | 836,518 | 684,464 | 392,132 | - | **4,219,380** |
| Yukon T. | - | 14,501 | 38,363 | 44,096 | 46,609 | 18,402 | 11,628 | 56,257 | **229,856** |
| Northwest T. | - | - | - | - | - | - | - | - | - |
| Nunavut | - | - | - | - | - | - | - | - | - |
| **Total** | **1,317,068** | **4,271,992** | **6,109,458** | **6,141,220** | **3,944,727** | **2,284,944** | **822,295** | **3,395,343** | **28,287,046** |

* *Populus* is the predominant genus by crown closure, basal area or volume

** Uneven-aged and unclassified

Source: Canada's Forest Inventory - CanFI 2001

Courtesy: Katja Power, Forest Inventory Officer - Canadian Forest Service

# APPENDIX II

| Volume (thousands) $m^3$ by Province & Territory - forest stands where predominant* genus is *Populus* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Volumes ('000') $m^3$ by Age Class** | | | | | | | | |
| Age class | 0 - 20 | 21 - 40 | 41 - 60 | 61 - 80 | 81 - 100 | 101 - 120 | 121+ | Other** | **Total** |
| Newfoundland & Labrador | - | 4 | 46 | 167 | 296 | 81 | 111 | 5 | **709** |
| Nova Scotia | 3 | 758 | 3,822 | 1,364 | 85 | 6 | - | 1,163 | **7,201** |
| Prince Edward Isl. | 135 | 908 | 767 | 361 | 81 | 14 | 3 | 874 | **3,143** |
| New Brunswick | - | 1,758 | 6,965 | 8,589 | 5,002 | 1,806 | 893 | 3,065 | **28,078** |
| Quebec | 6,038 | 37,398 | 137,359 | 103,406 | 25,219 | 1,911 | 157 | 956 | **312,445** |
| Ontario | 5,206 | 50,271 | 213,383 | 452,109 | 247,742 | 124,355 | 35,975 | - | **1,129,040** |
| Manitoba | 2 | 4,.995 | 12,676 | 12,369 | 6,140 | 285 | 1 | 214,848 | **251,316** |
| Saskatchewan | 1,192 | 5,499 | 52,423 | 101,294 | 73,896 | 78,562 | 20,407 | 50,201 | **383,474** |
| Alberta | 5,067 | 111,895 | 203,287 | 238,865 | 233,457 | 98,074 | 25,300 | - | **915,945** |
| British Columbia | 2 | 3,634 | 39,412 | 80,076 | 122,141 | 130,297 | 78,762 | - | **454,324** |
| Yukon T. | - | 1,228 | 2,996 | 6,171 | 7,491 | 5,199 | 4,097 | 3,997 | **31,179** |
| Northwest T. | - | - | - | - | - | - | - | - | - |
| Nunavut | - | - | - | - | - | - | - | - | - |
| **Total** | **17,645** | **218,348** | **673,136** | **1,004,769** | **721,550** | **440,589** | **165,706** | **275,109** | **3,516,853** |

* *Populus* is the predominant genus by crown closure, basal area or volume. The volume includes that of other species.

** Uneven-aged and unclassified

Source: Canada's Forest Inventory - CanFI 2001

Courtesy: Katja Power, Forest Inventory Officer - Canadian Forest Service

# APPENDIX III

Volume (thousands) $m^3$ of *Populus* in forest stands where *Populus* species occur in volume records

| Province or Territory | Area - '000' ha | Volumes ('000') $m^3$ | | | | | |
|---|---|---|---|---|---|---|---|
| | | Trembling aspen | Bigtooth aspen | Balsam poplar | Eastern cottonwood | Various *Populus* spp.*) | **Total** |
| Newfoundland & Labrador | 2,706 | 3,965 | - | 1 | | 22 | **3,988** |
| Nova Scotia | 181 | - | - | - | - | 6,716 | **6,716** |
| Prince Edward Isl. | 251 | - | - | - | - | 2,672 | **2,672** |
| New Brunswick | 3,267 | 78 | 1 | - | - | 36,711 | **36,791** |
| Quebec | 39,338 | 305,325 | 18,190 | 24,663 | 14 | 14,992 | **363,185** |
| Ontario | 29,349 | - | - | - | - | 1,404,706 | **1,404,706** |
| Manitoba | 10,542 | 201,514 | - | 35,682 | 136 | - | **237,333** |
| Saskatchewan | 19,197 | 420,892 | - | 63,569 | - | - | **484,461** |
| Alberta | 21,638 | 723,561 | - | 13,121 | - | 122,999 | **859,681** |
| British Columbia | 9,710 | 393,317 | - | 82,490 | - | - | **475,806** |
| Yukon T. | 4,500 | 48,253 | - | 10,871 | - | - | **59,124** |
| Northwest T. | 20,454 | 101,656 | - | 1,823 | - | - | **103,479** |
| Nunavut | 411 | 1,986 | - | 8 | - | - | **1,994** |
| **Total Canada** | **161,544** | **2,200,548** | **18,191** | **232,228** | **151** | **1,588,819** | **4,039,936** |

*) Various *Populus* spp. consist of combined categories:

- 'Poplar/aspen' at 1.6 billion $m^3$ (Nova Scotia at 6.7 million $m^3$, Prince Edward Isl. at 2.7 million $m^3$, New Brunswick at 36.7 million $m^3$, Ontario at 1.4 billion $m^3$ and Alberta at 120.7 million $m^3$);
- 'Other poplar' at 2.3 million $m^3$ (Newfoundland & Labrador at 21.9 thousand $m^3$, Alberta at 2.3 million $m^3$);
- 'Balsam poplar/bigtooth aspen/eastern cottonwood' at almost 15 million $m^3$ (all in Quebec).

Source: Canada's Forest Inventory - CanFI 2001

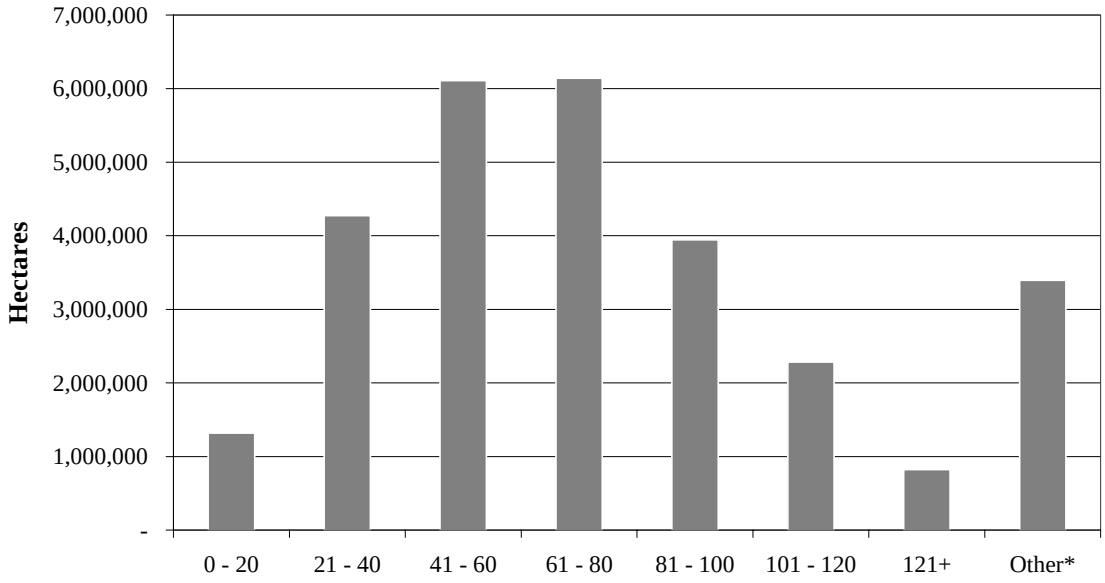
Courtesy: Katja Power, Forest Inventory Officer - Canadian Forest Service

# APPENDIX IV

## *APPENDIX IV (PAGE 1 OF 2)*

**Canada**

**Chart 1 Age Class Distribution of Stands where the predominant genus is *Populus***
**Other* refers to Unclassified and Uneven-Aged**



## *APPENDIX IV (PAGE 2 OF 2)*

**Chart 2**

**Alberta & Ontario**
**Age Class Distribution of Stands where the predominant genus is *Populus***
**Other* refers to Unclassified and Uneven-Aged**

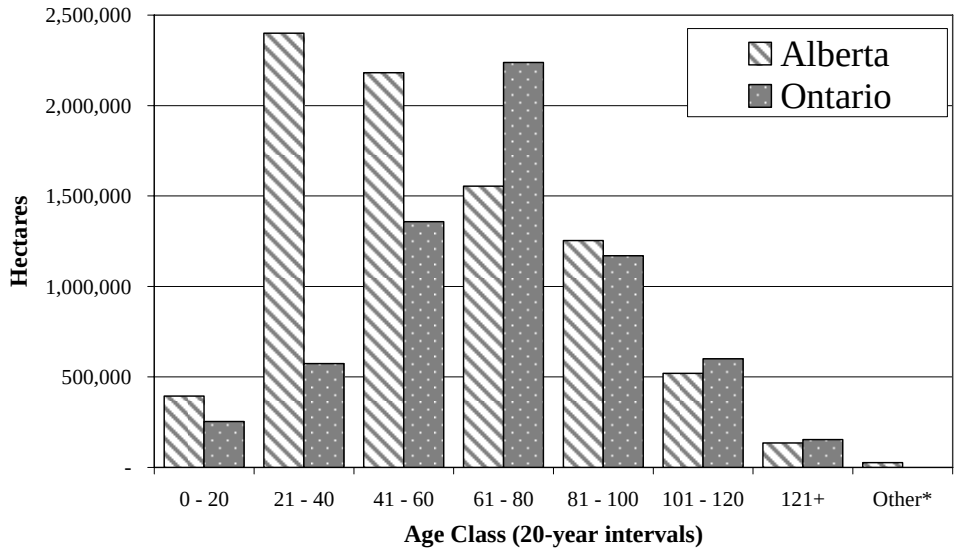
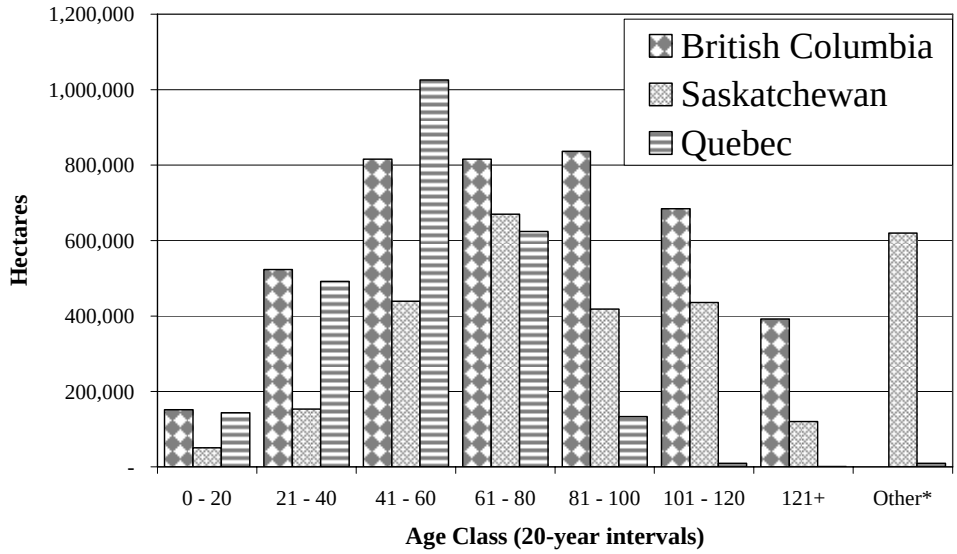



**Chart 3**

**British Columbia, Saskatchewan & Quebec**
**Age Class Distribution of Stands where the predominant genus is *Populus***
**Other* refers to Unclassified and Uneven-Aged**



# APPENDIX V

Annual harvests of *Populus* species in British Columbia by ownership

| | Harvest - $m^3$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Private Land** | | **Crown Land** | | **Total** | | **Grand Total** |
| Year | Cottonwood | Aspen | Cottonwood | Aspen | Cottonwood | Aspen | *Populus* |
| 2004 | 144,107 | 382,698 | 275,354 | 1,464,916 | 419,461 | 1,847,614 | **2,267,075** |
| 2005 | 176,589 | 477,606 | 310,555 | 1,528,615 | 487,144 | 2,006,221 | **2,493,365** |
| 2006 | 85,965 | 392,886 | 337,297 | 2,031,453 | 423,262 | 2,424,339 | **2,847,601** |
| 2007 | 108,959 | 332,433 | 361,938 | 2,044,146 | 470,897 | 2,376,579 | **2,847,476** |
| **Average Annual Harvest** | **128,905** | **396,406** | **321,286** | **1,767,283** | **450,191** | **2,163,688** | **2,613,879** |
| Species % of Total | 4.9% | 15.2% | 12.3% | 67.6% | 17.2% | 82.8% | 100.0% |

Note: Cottonwood = balsam poplar (*Populus balsamifera*) and black cottonwood (*P. trichocarpa*)
Source: Billing records of the Harvest Billing System (Ministry of Forests)
http://www15.for.gov.bc.ca/hbs/

# APPENDIX VI

Quebec statistics

**Allowable annual cut (AAC) as of the 31st of March 2007**

| | Volumes ('000') $m^3$ | | | | |
|---|---|---|---|---|---|
| | *Populus* species | Other hardwoods | Conifers | Total all species | *Populus* % of total |
| Public Forests | 3,495 | 7,361 | 24,344 | 35,200 | 9.9% |
| Private Forests | 2,312 | 4,100 | 5,557 | 11,969 | 19.3% |
| Total | 5,807 | 11,461 | 29,901 | 47,169 | 12.3% |

**Timber harvested in 2006-2007 fiscal year**

| | Volumes ('000') $m^3$ | | |
|---|---|---|---|
| | *Populus* species | Total all species | *Populus* % of total |
| Public Forests | 1,943 | 24,254 | 8.0% |
| Private Forests | 1,663 | 8,758 | 19.0% |
| Total | 3,606 | 33,012 | 10.9% |

**Timber consumed by primary processing plant in 2005 & 2006**

| | Volumes ('000') $m^3$ | | |
|---|---|---|---|
| | *Populus* species | Total all species | *Populus* % of total |
| 2005 | 5,146 | 70,681 | 7.3% |
| 2006 | 5,041 | 65,192 | 7.7% |

**Hardwood Imports and Exports**

| | Volumes ('000') $m^3$ | | | |
|---|---|---|---|---|
| | **Imports from** | | | |
| Year | Ontario | Other Provinces | Primarily US | Total |
| 2005 | 1,089 | 449 | 1,919 | 3,457 |
| 2006 | 1,233 | 316 | 1,907 | 3,456 |
| Average | 1,161 | 382 | 1,913 | 3,456 |

| | Volumes ('000') $m^3$ | | | |
|---|---|---|---|---|
| | **Exports to** | | | |
| Year | Ontario | Other Provinces | Primarily US | Total |
| 2005 | 26 | 114 | 64 | 204 |
| 2006 | 11 | 51 | 65 | 127 |
| Average | 19 | 82 | 65 | 166 |

| | Volumes ('000') $m^3$ | | | |
|---|---|---|---|---|
| **Net imports** | 1,142 | 300 | 1,848 | 3,290 |

Source: Québec's Forest Resources and Industry; A statistical report – 2008 Edition – Summary (English). See: http://www.mrn.gouv.qc.ca/english/publications/forest/publications/stat_edition_resumee/resumeanglais2008.pdf.

# APPENDIX VII-A

Updated 8 December 2008

Table A-1 - Herbicides registered for poplar and willow in various use categories[1]

| PCP# | Company | Active Ingredient | Product Name | Poplar plantation & SRIC Poplar crop & Other | Willow plantation & Other | Herbicide Type |
|---|---|---|---|---|---|---|
| 25230 | United Phosphorus Inc. | Napropamide | Devrinol 10-G Selective Granular | Nursery Populus | | pre-emergent |
| 25231 | United Phosphorus Inc. | Napropamide | Devrinol 50 DF Selective Flowable | Nursery Populus | | pre-emergent |
| 25297 | United Phosphorus Inc. | Napropamide | Devrinol 2-G Selective Granular | Nursery Populus | | pre-emergent |
| 28512 | United Phosphorus Inc. | Napropamide | Devrinol 2-G ready to Use Herbicide Selective Granular | Nursery Populus | | pre-emergent |
| 21209 | Syngenta Crop Protection Canada Inc. | Fluazifop-P-Butyl | Venture L | Poplar plantation | Willow - ornamental only | post-emergent |
| 12533 | Chematura Canada Co. | Dichlobenil | Casoron G-4 | Poplar plantation | Willow plantation | pre-emergent |
| 19899 | Monsanto Canada Inc. | Glyphosate | Vision Silvicultural | Poplar plantation | Willow plantation | post-emergent |
| 26401 | Cheminova Canada | Glyphosate | Forza Silvicultural | Poplar plantation | Willow plantation | post-emergent |
| 26828 | Cheminova Canada | Glyphosate | Cheminova Glyphosate | Poplar plantation | Willow plantation | post-emergent |
| 26884 | Dow AgroSciences Canada Inc. | Glyphosate | Vantage Forestry | Poplar plantation | Willow plantation | post-emergent |
| 27736 | Monsanto Canada Inc. | Glyphosate | Vision Max Silvicultural | Poplar plantation | Willow plantation | post-emergent |
| 24835 | BASF Canada Inc. | Sethoxydim | Poast Ultra Liquid Emulsifiable | SRIC Poplar | | post-emergent |
| 25684 | Nufarm Agriculture Inc. | Amitrol | Nufarm Amitrol 240 Liquid Bottom of Form | SRIC Poplar | | post-emergent |
| 27487 | Monsanto Canada Inc. | Glyphosate | Roundup Weathermax with Transorb 2 Technology Liquid | SRIC Poplar | | post-emergent |
| 27615 | Dow AgroSciences Canada Inc. | Glyphosate | Vantage Plus Max | SRIC Poplar | | post-emergent |
| 23545 | Dow AgroSciences Canada Inc. | Clopyralid | Lontrel 360 | SRIC Poplar | Willow - shelterbelt only | post-emergent |
| 25728 | Syngenta Crop Protection Canada Inc. | S-Metolachlor | Dual Magnum Agricultural | Stoolbeds Poplar | | pre- and post-emergent |
| 25729 | Syngenta Crop Protection Canada Inc. | S-Metolachlor | Dual II Magnum Agricultural | Stoolbeds Poplar | | pre- and post-emergent |

- PCP# = Pest Control Products Number
- Poplar includes aspen.
- The author, the Pesticide Working Group and the Poplar Council of Canada do not assume liability for crop losses, safety or environmental hazards caused by the use of practices or products listed.

[1] http://pr-rp.pmra-arla.gc.ca/portal/page?_pageid=34,17551&_dad=portal&_schema=PORTAL .

# APPENDIX VII-B

Updated 8 December 2008

| Table B-1 - Herbicides approved for poplar pending final label | | | | | | |
|---|---|---|---|---|---|---|
| **PCP#** | **Company** | **Active Ingredient** | **Product Name** | **SRIC Poplar crop** | **Willow** | **Herbicide Type** |
| 16279 | E.I. Du Pont Canada Co. | Linuron | Lorox L Liquid* | SRIC Poplar - western Canada only | | Post-emergent |

- * Lorox L (linuron) –also under application for national registration/labelling for both SRIC poplar and SRIC willow as a pre- and post-emergent.

| Table B-2 - Fungicides registered for poplar and willow in various uses[1] | | | | | | |
|---|---|---|---|---|---|---|
| **PCP#** | **Company** | **Active Ingredient** | **Product Name** | **Poplar plantation & SRIC Poplar crop & Other** | **Willow plantation & Other** | **Fungicide** |
| 12279 | Nippon Soda Co., Ltd. | Thiophanate-methyl | Senator 70WP 1 | Aspen and poplar | | Fungicide |
| 25343 | Nippon Soda Co., Ltd. | Thiophanate-methyl | Senator 70WP | Aspen and poplar | | Fungicide |
| 27297 | Nippon Soda Co., Ltd. | Thiophanate-methyl | Senator 70WP WSB | Aspen and poplar | | Fungicide |

- PCP# = Pest Control Products Number
- Poplar includes aspen.
- The author, the Pesticide Working Group and the Poplar Council of Canada do not assume liability for crop losses, safety or environmental hazards caused by the use of practices or products listed.

| Table B-3 - Pesticides under active URMULE for poplar and/or willow | | | | | | |
|---|---|---|---|---|---|---|
| **PCP#** | **Company** | **Active Ingredient** | **Product Name** | **Poplar plantation & SRIC Poplar crop & Other** | **Willow plantation & Other** | **Pesticide Type** |
| 24913 | Dow AgroSciences Canada Inc. | Oxyfluorfen | Goal 2XL Emulsifiable | SRIC Poplar | Pending SRIC Willow | pre-emergent |
| 16279 | E.I. Du Pont Canada Co. | Linuron | Lorox L Liquid* | SRIC Poplar | SRIC Willow | pre- and post-emergent |
| New | Valent U.S.A. Corporation | Flumioxazin | Chateau (51% WDG) | SRIC Poplar | SRIC Willow | pre- and post-emergent |
| 25940 | Bayer CropScience Inc. | Tebuconazole | Folicur 432 F | SRIC Poplar | SRIC Willow | Fungicide |

- PCP# = Pest Control Products Number
- Poplar includes aspen.
- * Lorox L (linuron) – Now also applied for national registration/labelling for both SRIC poplar and SRIC willow as a pre- and post-emergent.
- The author, the Pesticide Working Group and the Poplar Council of Canada do not assume liability for crop losses, safety or environmental hazards caused by the use of practices or products listed.

[1] http://pr-rp.pmra-arla.gc.ca/portal/page?_pageid=34,17551&_dad=portal&_schema=PORTAL .

# APPENDIX VIII

Glossary of frequently used terms

| | |
|---|---|
| AAC | See - Allowable annual cut |
| Agroforestry | Agriculture in which there is integrated management of trees or shrubs along with conventional crops or livestock |
| Allowable annual cut | Allowable annual cut - The regulated amount of annual harvest. |
| Aspen | Aspen is the common name for *Populus* species, such as *Populus tremuloides*, *P. grandidentata* and *P. tremula* (not native to North America) in the *Populus* section – formerly *Leuce* – (Aspens and white poplars). Hybrid aspen thus refers to the artificial interspecific hybrids of *P. tremuloides* and *P. tremula* or *P. davidiana* (Chinese or Korean poplar). |
| Clone | An individual or group of individuals reproduced asexually from a single organism, and therefore genetically identical to the parent. |
| Cutting | Unrooted stem or root section originating from a plant and used for vegetative (asexual) propagation. Cuttings are<br>usually dormant when used. |
| Hybrid aspen | Aspen plant (or group of plants) created by crossing two distinct species of aspen. |
| Hybrid poplar | Poplar plant (or group of plants) created by crossing two distinct species of poplar (or two individuals within one species with very distinct characteristics). |
| Intersectional hybrids | Interspecific hybrids created between species from different sections. For instance between the eastern cottonwood (*Populus deltoides*) of the Aigeiros section and the balsam poplar (*Populus balsamifera*) of the Tacamahaca section. |
| Interspecific hybrids | Hybrids created between different species, e.g. between black cottonwood (*Populus trichocarpa*) and eastern cottonwood (*Populus deltoides*), designated as *Populus trichocarpa* (♀) × *P. deltoides* (♂), or simply TxD or TD; ♀ is the symbol for female and ♂ is the symbol for male. |
| Intraspecific breeding or improvement | Crosses created between trees from the same species, e.g. between *Populus trichocarpa* trees, designated as *Populus trichocarpa* (♀).× *P. trichocarpa* (♂), or simply T × T or TT. |
| Poplar | Poplar is the common name for all non-aspen species, such as *P. balsamifera*, *P. trichocarpa* (both native to North America), *P. maximowiczii* and *P. laurifolia* in the *Tacamahaca* section (Balsam poplars), and *P. deltoides* (native to North America) and *P. nigra* in the *Aigeiros* section (Cottonwoods and black poplar). Hybrid poplar thus refers to the natural or artificial interspecific and/or intersectional hybrids. |
| *Populus* | The genus *Poplulus*, which includes poplars, aspens and cottonwoods |
| *Salix* | The genus *Salix* (willows). |
| Set | Rooted whip. Also referred to as stecklings in Quebec. |
| SRIC | Short-rotation-intensive-culture. Poplar crops that are established and managed using an agronomic approach on cleared (usually agricultural) land. |
| Steckling | A set, or rooted whip used in Quebec. |
| TOF | Trees outside forests |
| Whip | Unrooted stem or shoot originating from a plant and used for vegetative propagation. The size is usually between 1.5 and 2.0 m (5.0-6.5 ft.). A set is a rooted whip. |
| Willow | Trees in the genus *Salix*, including its many hybrids |

# APPENDIX IX

List of contacts - personal communication

Updated 8 December 2008

| Personal Contact | Organization | Province |
|---|---|---|
| Al Bertschi | Alberta-Pacific Forest Industries Inc. | Alberta |
| Alex Mosseler | Canadian Forest Service | New Brunswick |
| Armand Séguin | Natural Resources Canada - Canadian Forest Service | Quebec |
| Barb Thomas | University of Alberta & Alberta-Pacific Forest Industries Inc. | Alberta |
| Bill Schroeder | Prairie Farm Rehabilitation Administration - Shelterbelt Centre | Saskatchewan |
| Brenda Callan | Canadian Forest Service | British Columbia |
| Brian Barkley | Eastern Ontario Model Forest | Ontario |
| Brigitte Bigué | Réseau Ligniculture Québec | Quebec |
| Bruce Walders | Ministry of Forests and Range | British Columbia |
| Carl Douglas | Department of Botany, University of British Columbia | British Columbia |
| Chang-Yi Xie | Ministry of Forests and Range | British Columbia |
| Charles Provost | Charles Provost et associés | Quebec |
| Chuck Kaiser | Alberta-Pacific Forest Industries Inc. - 2004 | Alberta |
| Claude LeBel | Norbord Inc. | Quebec |
| Dan Carson | Kruger Products Limited | British Columbia |
| Danielle Garon | Norampac Cascades Canada Inc. | Quebec |
| Douglas Currie | ForestFirst (used to be Saskatchewan Forest Centre) | Saskatchewan |
| Éric Lapointe | Domtar Inc.(Windsor) | Quebec |
| Florance Niemi | Daishowa-Marubeni International Ltd. | Alberta |
| Francis Allard | Agro Énergie | Quebec |
| Fred Radersma | Ainsworth Engineered Canada LP | Alberta |
| Gisèle Bélanger | Direction des programmes forestiers, Service de l'aménagement forestier | Quebec |
| Jaime Lypowy | University of Alberta | Alberta |
| Jim Hendry | Stewardship Coordinator | Ontario |
| Jim Richardson | Poplar Council of Canada | Ontario |
| John Doornbos | Poplar Council of Canada | Alberta |
| John Kort | Prairie Farm Rehabilitation Administration – Regina - 2004 | Saskatchewan |
| Katja Power | Canadian Forest Service | British Columbia |
| Ken Plourde | Alberta-Pacific Forest Industries Inc. | Alberta |
| Larry White | ForestFirst (used to be Saskatchewan Forest Centre) | Saskatchewan |
| Malcolm Campbell | University of Toronto | Ontario |
| Michael Carlson | Ministry of Forests and Range | British Columbia |
| Michel Labrecque | Institut de recherche en biologie végétale Jardin botanique (IRBV) | Quebec |
| Michelle Sulz | Alberta-Pacific Forest Industries Inc. | Alberta |
| Monique Wismer | Saskatchewan Research Council | Saskatchewan |
| Pierre Gagné | Ministère des Ressources naturelles, de la Faune (MRNF) | Quebec |

| Personal Contact | Organization | Province |
|---|---|---|
| Pierre Périnet | Ministère des Ressources naturelles, de la Faune (MRNF) | Quebec |
| Randy McNamara | Alberta-Pacific Forest Industries Inc. | Alberta |
| Richard Krygier | Canadian Wood Fibre Centre - Canadian Forest Service | Alberta |
| Roger Touchette | Ministère des Ressources naturelles, de la Faune (MRNF) | Quebec |
| Shawn Mansfield | Department of Wood Science, University of British Columbia | British Columbia |
| Toma Guillemette | Université-du-Québec-en-Abitibi-Témiscamingue | Quebec |
| Werner Kurz | Canadian Forest Service - 2004 | British Columbia |

# APPENDIX XI

## UPDATES - 8 DECEMBER 2008

Several updates to the report were made on 8 December 2008.

### UPDATE 6.4.2.2 HYBRID POPLAR - SRIC CROPS (SEE 6.4.2.2)

Table 6 - Approximate area of hybrid poplar short-rotation-intensive-culture (SRIC) crops in Canada

| | SRIC crops | | | |
|---|---|---|---|---|
| | Reported in 2004 for 2000-2003 | Planted 2004-2007 | Total crops to and incl. 2007 | Planted 2008 |
| | Hectares | Hectares | Hectares | Hectares |
| Kruger Products Ltd. - British Columbia (*) | 1,000 | 70 | 1,070 | 14 |
| Catalyst Paper Corp. - British Columbia (**) | 1,317 | 0 | 200 | 0 |
| Alberta-Pacific Forest Ind. Inc. - Alberta (***) | 700 | 4,940 | 5,640 | 1,140 |
| Ainsworth Engineered Canada LP - Alberta | 0 | 215 | 215 | 250 |
| ForestFirst – Saskatchewan ($^{+}$) | Unknown | Unknown | 300 | Unknown |
| Domtar Inc. – Ontario ($^{++}$) – Updated 8 Dec. | 2,000 | 0 | 2,500 | 0 |
| MRNF – Quebec ($^{+++}$) | 150 | 200 | 350 | 0 |
| **Total** | **5,167** | **5,425** | **10,275** | **1,404** |

(*) Total reported in 2004 for the period 2000-2003 is an estimate.

(**) Estimated remainder of SRIC crops

(***)The reported hectares in the 2004 report (2,617 ha) does not correspond with the corrected hectares of 700 ha.

($^{+}$) ForestFirst facilitates establishment of SRIC hybrid poplar crops.

($^{++}$) Domtar Inc. in Ontario suspended its hybrid poplar program.

($^{+++}$) In the 2004 report hectares reported under SRIC should have been reported under Forest Plantations. The SRIC levels in the table are estimates from the «ministère des Ressources naturelles et de la Faune» (MRNF - Quebec).

Source: Personal communication with companies and the «ministère des Ressources naturelles et de la Faune» (MRNF – Quebec) in 2007.

Domtar Inc. in Ontario has shut down its poplar farming operations indefinitely following the closure of the pulp mill at Cornwall, Ontario. It is estimated that 500 hectares of SRIC hybrid poplar crops still exist that are owned by Domtar Inc. An estimated 2,000 hectares of privately-owned poplar crops also still exist. These crops are still being

harvested by independent companies and all the wood is destined for the Domtar Inc. mill in Windsor (Quebec), where it is part of the pulp furnish.[1]

### UPDATE 6.4.2.2.5 PESTICIDES (SEE 6.4.2.2.5)

Appendices VII-A ('Herbicides registered for poplar and willow in various use categories' and 'Herbicides approved for poplar pending final label', respectively) and VII-B were updated with one extra entry in Appendix VII-A (Table A-1), which resulted in a shift of the information under 'Herbicides approved for poplar pending final label' at the bottom of Table A-1, which is now Table B-1. The old Table B-1 and B-2 have now become new Table B-2 and B-3 respectively.

### UPDATE 8 POPLAR GENOME PROJECT (SEE 8)

**Completed and ongoing projects**

The Genome Canada Treenomix I project, funded by Genome Canada 2001-2005, located at the University of British Columbia (UBC)[2] was completed in 2005. The focus was on the regulation of wood formation and pest resistance in forest trees, in particular in spruce and poplar, two of the most important forest tree species in Canada. The work used the model plant organism *Arabidopsis* for comparative studies.

Carl Douglas[3] reported that "*Other outcomes were* [the]*generation of a physical map, and several whole genome gene expression studies using microarrays, a large data base and collection of expressed genes (ESTs), and collection of full-length copies of expressed genes (full-length cDNAs). These expression studies revealed the expression patterns of hundreds of genes in response to insect attack, pathogen infection, and during xylem development*". Additional work was initiated on natural genetic variation in *Populus* and phenotypic variation in wood traits in native aspen (*Populus tremuloides*) populations.

Other projects[4] currently ongoing at UBC involve "*elucidating the role of sink strength and sucrose metabolism (biochemically and transcriptionally) on growth and development in poplar*" and "*evaluating several candidate genes targeted towards cell wall development and chemistry via transgenic approaches in hybrid poplar*".

There are several cooperative research projects[5] involving

- the University of British Columbia, the University of Toronto[6] and Queens University[7], where researchers investigate molecular and biochemical regulation of growth in poplar. This research is aimed at developing an understanding of increases in poplar biomass as determined by leaf function, and of interaction with

[1] Brian Barkley, Jim Hendry – personal communication.
[2] The University of British Columbia (UBC) is located in Vancouver, British Columbia, Canada.
[3] Carl Douglas – personal communication.
[4] Shawn Mansfield – personal communication.
[5] Shawn Mansfield, Malcolm Campbell – personal communication.
[6] The University of Toronto (U of T) is located in Toronto, Ontario, Canada.
[7] Queens University is located in Kingston, Ontario, Canada.

environmental stimuli, like drought. Researchers hope to develop molecular markers for this. The project is funded through a Natural Sciences and Engineering Research Council of Canada (NSERC) Strategic Grant; and

– the University of British Columbia, the University of Toronto and Simon Fraser University[1], to develop an understanding of the biochemical and molecular basis of drought resistance in hybrid poplar genotypes, and to develop the molecular markers for this. This project is also funded through an NSERC Strategic Grant.

In the context of poplar drought resistance it is of interest to report that a Poplar Drought Network was established in cooperation with researchers from the University of Alberta[2], Simon Fraser University, Agriculture and Agri-Food Canada (AAFC) – Shelterbelt Centre[3], the University of British Columbia and Alberta-Pacific Forest Industries Inc.(Al-Pac)[4], and others.

The University of Toronto established a compendium of data to develop "*a web-based resource for analysis of poplar genome expression across multiple tissues and multiple treatments (e.g. drought)*"[5].

**New projects**

– ***AGIP Project***

Genome BC, 'Applied Genomics Innovation Program' (AGIP[6]) approved a new project 'Optimized *Populus* feedstocks and novel enzyme systems for a British Columbia bioenergy sector'. This project started in July 2008 and is based "*on priorities articulated by the Genome BC Bioenergy Sector Strategy, focused on understanding genes and allelic variation in natural populations of Populus trichocarpa that contribute to wood and biofuels (cellulosic ethanol) traits*"[7]. This project is carried out with additional collaborators at UBC and the University of Victoria[8], as well as international collaborators at the Department of Energy, Oak Ridge National Laboratory in Tennessee, USA, the Umeå Plant Science Center in Umeå, Sweden, and the USDA Forest Service Forest Products Lab in Madison, Wisconsin, USA. Other collaborators include the British Columbia Ministry of Forests and Range, Research Branch in British Columbia, Canada, and GreenWood Resources Inc., of Portland, Oregon, USA.

The data that will be generated in this AGIP project will provide a basis for future marker-assisted selection (MAS) in poplar for conventional breeding purposes. For this to become reality, active cooperation with the 'user community' would be needed.

[1] Simon Fraser University (SFU) is located in Vancouver, British Columbia, Canada.
[2] The University of Alberta is located in Edmonton, Alberta, Canada.
[3] The AAFC Shelterbelt Centre of the Prairie Farm Rehabilitation Administration (PFRA) is located in Indian Head, Saskatchewan, Canada.
[4] Alberta-Pacific Forest Industries Inc. (Al-Pac) is located near Boyle, Alberta, Canada.
[5] Malcolm Campbell – personal information. See http://www.bar.utoronto.ca/efppop/cgi-bin/efpWeb.cgi.
[6] http://www.genomebc.ca/genomics_programs/research_projects/agip/populus.htm.
[7] Carl Douglas, Shawn Mansfield – personal communication.
[8] The University of Victoria (UVIC) is located in Victoria, British Columbia, Canada.

– ***Tree defence response through genomics***

A new research project "Understanding Tree Defence Response through Genomics" is funded for a three-year period (2008–2011) by the Canadian Genomics R&D Initiative; this is funding aimed at Federal Government of Canada laboratories[1]. The project also received a small NSERC grant. This project is centered at the Laurentian Forestry Centre[2] in Québec City, Quebec, Canada and is carried out with the cooperation of the National Research Council (NRC) - Plant Biotech Institute[3], the University of Victoria, «L'Institut National de la Recherche Agronomique» (INRA) in France and Mississippi State University[4].

The research concentrates on the *Melampsora-Populus* interaction and hopes to identify gene functions with the following project deliverables (as quoted from Armand Séguin[5]):

1. *"A list of proven candidate resistance genes in the context of the poplar-rust interaction:*
    a. *Candidate genes that are proven markers for early trait selection for disease resistance;*
    b. *Promising gene candidates could also by used for the future development of genetically modified trees that are more resistant to pests and would rely less on pesticides during plant production in nurseries. These trees will not rely on non-plant genes, thereby eliminating potential concerns related to genetic pollution and the ethical issues associated with the transferring of genes across species barriers.*
2. *New knowledge (scientific publications and methods) on the molecular processes of poplar rust resistance:*
    a. *This knowledge will serve as the foundation to the development of biological control methods based on gene function discovery;*
    b. *Databases on genomic components involved in tree resistance to fungal diseases.*
3. *A gene list for population studies on gene flow in poplar".*

[1] Armand Séguin – personal communication.
[2] Laurentian Forestry Centre of the Canadian Forest Service – Natural Resources Canada.
[3] National Research Council (NRC) - Plant Biotech Institute in Saskatoon, Saskatchewan, Canada
[4] Mississippi State University is located in Starkville, Mississippi, USA.
[5] Armand Séguin – personal communication.