

HARDINESS AND GROWTH OF WOODY ORNAMENTAL PLANTS

**REPLOQ RESULTS
AND RECOMMENDATIONS**

VOLUME IV

**Claude Richer
Jacques-André Rioux
Chantal Gauthier**




CENTRE DE RÉFÉRENCE
EN AGRICULTURE ET
AGROALIMENTAIRE
DU QUÉBEC



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HARDINESS AND GROWTH OF WOODY ORNAMENTAL PLANTS VOLUME IV

REPLOQ Results and Recommendations

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FOREWORD

This fourth volume was produced by REPLOQ (Réseau d'essais des plantes ligneuses ornementales du Québec, or the Quebec woody ornamental plant testing network) under the auspices of the ornamental horticulture committee of the Centre de référence en agriculture et agroalimentaire du Québec (CRAAQ), the Quebec agriculture and agri-food reference centre.

This volume contains the results and recommendations on the woody ornamental species evaluated by REPLOQ in 1991-97.

The Latin nomenclature used for species and cultivars corresponds to that in the glossary on woody ornamental plants (Index of ornamental woody plants of Quebec) published by the CPVQ (Plant Production Council of Quebec).

A fifth and last volume is planned to disseminate the results of trials carried out in 1993-99. Each volume contains results from two different series of plantings, involving roughly 80 species and cultivars.

ACKNOWLEDGEMENTS

We are particularly grateful to the Director of the Horticultural Research and Development Centre, Dr. Denis Demars, for supporting this research project for over ten years. Once the research itself had been completed, he encouraged us to complete the writing and publication of the series, and provided the resources needed.

The REPLOQ trials were made possible by financial assistance from Agriculture and Agri-Food Canada and the Quebec Department of Agriculture, Fisheries and Food.

The joint publication of this volume with CRAAQ and Canadian Government Publishing has allowed us to produce a professional, bilingual document, containing a wealth of information for nursery growers and horticulturists. The English translation, by Agriculture and Agri-Food Canada, provides greater opportunities for the wider dissemination of this information.

A special thanks goes to Isabelle Lizée, secretary at Agriculture and Agri-Food Canada and employee of Claude Richer, who had the patience to go over these texts a number of times and who has done remarkable work in helping to produce the final version of the document.

Lastly, roughly one hundred municipalities in the regions covered by the trials helped to take charge of the plants after the trial, and helped disseminate the results and put in place the specific infrastructures required to make the plants better known. They also provided financial support for the manpower required to care for the REPLOQ plots in summer.

Again, we thank everyone very much!

The Corporative Group of the *Centre de référence en agriculture et agroalimentaire du Québec*

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et agroalimentaire du Québec wishes to
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et de l'Alimentation*



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HARDINESS OF WOODY ORNAMENTAL PLANTS

The climatic conditions affecting the winter survival of plants vary from region to region. Latitude, longitude and altitude are some of the criteria used by researchers to define hardiness zones.

Over the years, a number of different systems for defining hardiness zones have been proposed. The debate over the notion of hardiness zones is constantly evolving, however, due to new findings on plant behaviour. The REPLOQ trials have allowed additional progress to be made in this area.

In the United States, hardiness zones for trees and shrubs are based solely on average monthly minimum temperatures. The United States Department of Agriculture (USDA) has developed a system of plant hardiness zones that covers all of North America, based on records of minimum temperatures at 450 stations from 1898 to 1938. The contiguous United States and southern Canada (from the southern US to central Canada and including southern Quebec) were divided into ten zones based on a 5.5 °C temperature difference in average minimum temperatures. Each zone was further subdivided into two subzones representing 2.8°C intervals. The map was updated in 1992, based on information compiled from close to 14,000 weather stations over ten years.

In Canada, a number of researchers have attempted to define hardiness zones. Ouellet and Sherk (1967) proposed hardiness zones based mainly on mean monthly minimum temperatures, but also on the length of the frost-free period, snow cover and wind speed. Zones were based on the probability of adaptation in 174 species and cultivars of woody plants at 108 stations, 15 of which were in Quebec. Their system divided Quebec into five zones and five subzones, ranging from zone 1a (the coldest) to zone 5b (the warmest). A hardiness zone map can be found on the following page. Other researchers have made modifications to this work, incorporating the notions of thermal capacity based on the number of degree-days above the 5.5°C threshold during the frost-free period in 1931-60, as well as data from scientific studies for the period 1965-76. The table on page vii shows the correspondence between the ten US and nine Canadian zones for comparison purposes.

Landry *et al.* have identified eight adaptation zones for woody ornamental plants in Quebec, based on a synthesis of interrelated bioclimatic data to better express the difference or homogeneity of natural regions in Quebec.

Since Ouellet and Sherk only dealt with 174 species and cultivars, over the years, the data have been extrapolated to assign hardiness ratings to species and cultivars from other regions, with the help from observers in different countries. Some authors of popularized horticultural works define the term hardiness very narrowly as a plant's ability to survive under difficult conditions, which is a highly subjective definition. Others use the terms "hardy" and "nonhardy" in an absolute sense. The notion of plant hardiness, however, is a complex and very relative one, depending on the genetic capital of the plant as well as environmental and particularly climatic conditions. REPLOQ was established to concretely assess the behaviour and hardiness of ornamental woody plants.

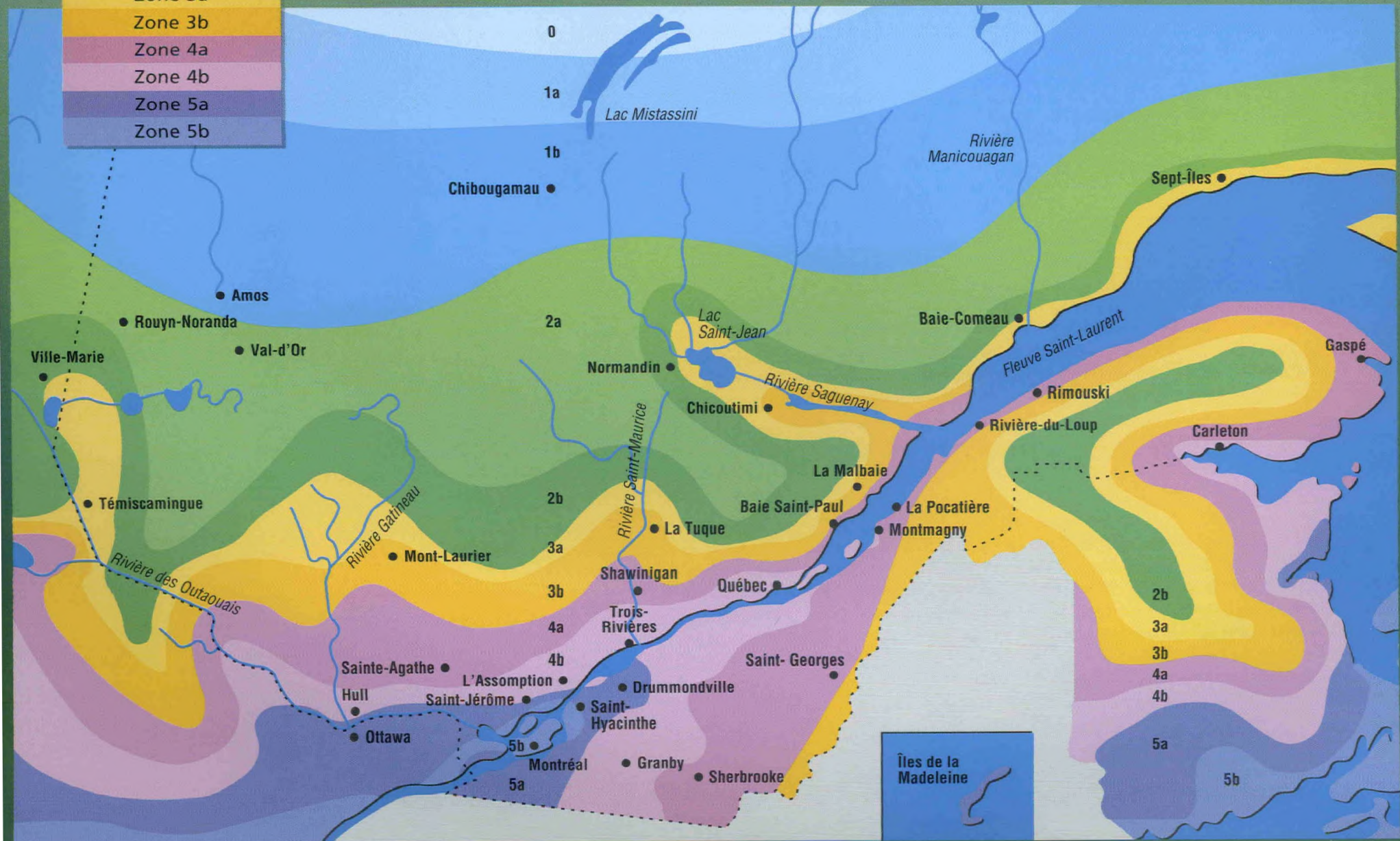
REPLOQ's work has led to the development of a NEW way of defining the hardiness of a plant, based on three aspects of hardiness;

- A rating for SURVIVAL, corresponding to the coldest Canadian hardiness zone where the plant is able to survive, although it suffers winter damage making it unable to express its ornamental characters;
- A rating for USE, corresponding to the coldest Canadian hardiness zone where all or at least part of the plant's ornamental potential is achieved, despite the fact that it suffers winter damage;
- A rating for FULL ORNAMENTAL POTENTIAL, corresponding to the coldest Canadian hardiness zone where the plant is generally not affected by the climatic conditions and where it achieves its full ornamental potential.

ZONES DE RUSTICITÉ

WINTER HARDINESS ZONES

Zone 0
Zone 1a
Zone 1b
Zone 2a
Zone 2b
Zone 3a
Zone 3b
Zone 4a
Zone 4b
Zone 5a
Zone 5b



COMPARISON OF U.S. AND CANADIAN HARDINESS ZONE MAPS OF STUDY AREA

The Canadian hardiness zone map is based on seven climatic parameters (mean minimum and maximum temperatures during the coldest months, precipitation, snow cover, wind speed), while the only criteria used in establishing the U.S. map (updated and published by the USDA in 1990) was the average annual minimum temperature.

Comparing the zone maps for the study area (Quebec and northeastern Ontario), the following observations and overall comparisons can be made (see table below):

- U.S. zone 2 includes all of Canadian zone 1 and a part of Canadian zones 0 and 2.
- U.S. zone 3 includes most of Canadian zones 2 and 3 and some portions of zone 4;
- U.S. zone 4 includes Canadian zone 5 and a large part of zone 4 (which takes in the Eastern Townships, Beauce, lower Laurentians and much of the land along the St. Lawrence estuary).

U.S. zones (USDA 1990)	Mean annual minimum temperature	Canadian zones (Ouellet and Sherk 1967)	Corresponding regions
1a - 1b	below -50 °F below -46 °C	0a - 0b	Northern Quebec (including part of Lake Mistassini) and Northern Ontario; Saskatchewan: La Ronge; Alberta: Fort McMurray
2a - 2b	-50 to -35 °F -46 to -37 °C	1a - 1b	Manitoba: Flin Flon; Saskatchewan: Prince Albert; Alberta: Banff; British Columbia: Kleena Kleene
3a - 3b	-35 to -20 °F -37 to -29 °C	2a - 2b	Quebec: Noranda; Ontario: Red Lake; Saskatchewan: Saskatoon, Regina; Alberta: Grande Prairie; British Columbia: Babine Lake
		3a - 3b	Quebec: Témiscamingue, Mont-Joli; Ontario: Thunder Bay; Saskatchewan: Swift Current; Alberta: Calgary, Edmonton
4a - 4b	-20 to -10 °F -29 to -23 °C	4a - 4b	Newfoundland: Gander; New Brunswick: Grand-Sault; Quebec: Gaspé, Quebec City, Lower St. Lawrence; Ontario: Sudbury
		5a - 5b	Newfoundland: St. John's; Nova Scotia: Sydney; New Brunswick: Fredericton; Ontario: Ottawa; Quebec: Montreal

The REPLOQ test sites can be classified as follows under the two systems:

Site	U.S. system	Canadian system	Site	U.S. system	Canadian system
Sainte-Anne- de-Bellevue	4b	5b	Deschambault	4a	4b
Sainte-Clotilde	4b	5b	Sainte-Foy	4b	4b
Saint-Hyacinthe	4b	5a	La Pocatière	4b	4a
L'Assomption	4a	5a	Normandin	3a	2b
			Kapuskasing	2b	2a

INFORMATION ON REPLOQ TESTING

REPLOQ is a co-operative research project whose aim is to obtain information on the behaviour of species and cultivars of woody plants, both indigenous and introduced, with ornamental potential when grown under normal Quebec growing conditions (soil and climate).

The results and recommendations presented in this report are intended to provide more detailed information about the behaviour and hardiness of various woody plant species and cultivars evaluated over a five-year period.

For these tests, Quebec was divided into three adaptation zones in order to identify the biophysical and climatic characteristics which might influence the growth of ornamental woody plants. REPLOQ has eight or nine test sites, depending on the year, located in three adaptation zones (see map below).

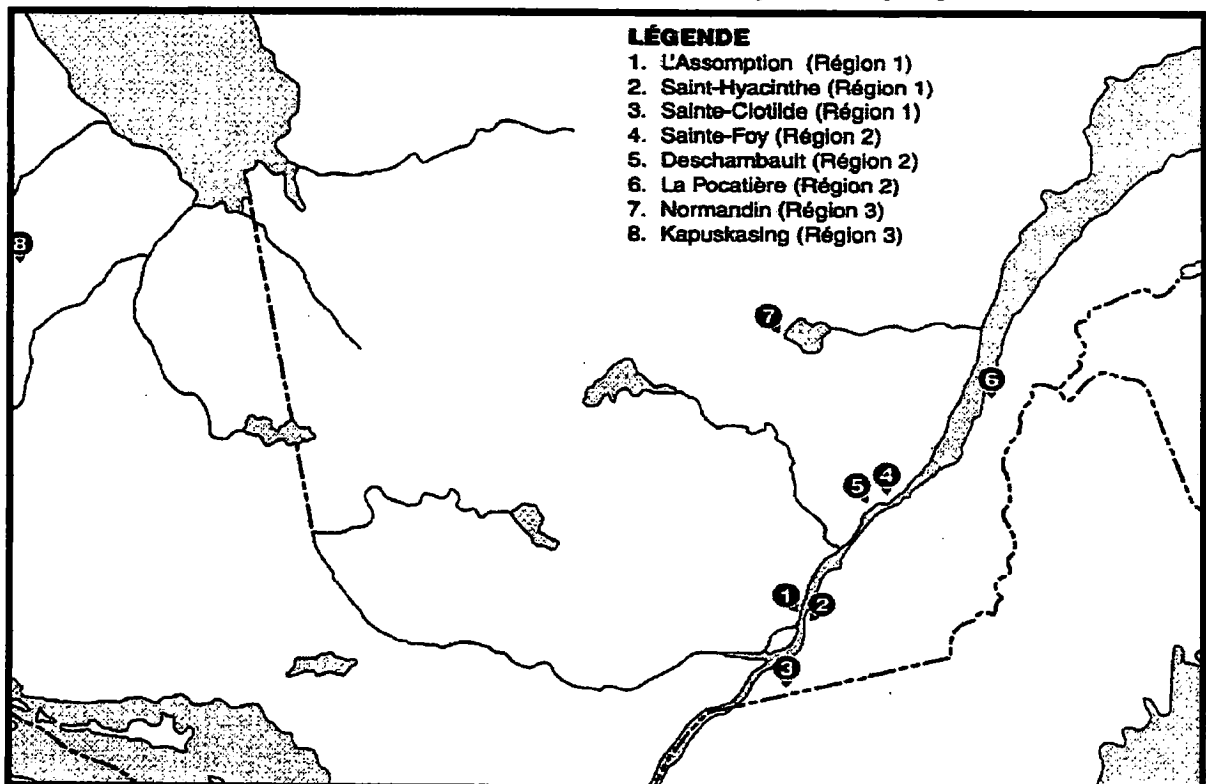
For each species, we provide a description as well as the plant's climatic and soil requirements. We also include the findings on winter damage and growth obtained during our testing. Based on the results obtained, we can formulate recommendations for growing and using these plants, while at the same time defining new zones.

In this volume, a new way of defining the hardiness of woody plants developed by REPLOQ is based on three aspects; a rating for survival, for use and for a full ornamental potential which is described in page vi.

Zone 1: The Montreal and Outaouais regions;

Zone 2: The Mauricie, Quebec City, Beauce, Eastern Townships and Charlevoix regions;

Zone 3: The Saguenay-Lac-Saint-Jean, Lower St. Lawrence, Abitibi-Témiscamingue and Gaspé region.



INFORMATION ON REPLOQ TESTING...

These recommendations were verified for plants obtained from specific clones, with respect to seedlings and cuttings. The authors are aware that different clones or breeding lines might have produced different results. It must be borne in mind that a plant has a unique genetic potential and that exceptions are always possible, especially when dealing with seedlings.

Each species is divided into one of the following two categories: deciduous plants or evergreen plants. Each of these categories is further divided into four subdivisions. For each, specific species were identified as control plants. These control plants were introduced in every planting year in order to compare their behaviour over time. This makes it possible to identify the years when the winter weather conditions were particularly harsh. A control plant must be as adapted as possible to the test regions.

The species used as controls were as follows:

1. Large trees (more than 5 m)
Control: *Acer saccharinum* or
Larix laricina
2. Medium-sized trees (3 to 5 m)
Control: *Malus baccata* or
Thuja occidentalis
3. Shrubs (less than 3 m)
Control: *Cornus alba* 'Elegantissima' or
Juniperus sabina or
Juniperus sabina 'Blue Danube'
4. Climbing and creeping plants
Control: *Clematis virginiana*

For the control species, the descriptive report is completed the first year it is introduced, and thereafter only the test results are provided.

The species introduced in 1984 and evaluated until 1989 are presented in the form of individual descriptive reports, illustrated with colour plates (see the list of publications to find out how to obtain these descriptive reports). The species and cultivars introduced in 1985 and 1986 were evaluated until 1990 and 1991 and have been published in the form of individual descriptive reports in a book named "Hardiness and growth of woody ornamental plants in Quebec", publication number 95-0070. The species and cultivars introduced in 1987 and 1988 were evaluated until 1992 and 1993 and have been published in the

form of individual descriptive reports in a book named "Hardiness and growth of woody ornamental plants in Quebec, volume II", publication number VR 221. The species and cultivars introduced in 1989 and 1990 were evaluated until 1994 and 1995 and have been published in the form of individual descriptive reports in a book named "Hardiness and growth of woody ornamental plants in Quebec, volume III" publication number is VT 008. The species and introduced in 1991 and 1992 were evaluated until 1996 and 1997 and are presented in the form of individual descriptive reports in this present book.

The evaluations were conducted on test plots with no winter protection. For private use, in a more protected environment, the plants might react differently.

REPLOQ is a research project which includes other evaluation components, which are explained in the document entitled "Plantes ligneuses ornementales - méthode d'évaluation" (AGDEX 270/30, publication 95-0065).

All this work was obviously the result of close collaboration among many individuals. We would like to thank the heads of each evaluation site and their teams:

The following individuals were involved in the 1991 and 1992 plantings:

Sainte-Clotilde	Michel Fortin
	Alain Lévesque
L'Assomption	Jacques Côté and
	Raymond Pellerin
Saint-Hyacinthe	Gaëtan Pion
Sainte-Foy	Jacques-André Rioux,
	Éric Dugal and Marie-Pierre Lamy
Deschambault	Sylvie Atkins
La Pocatière	Michel Auger
Normandin	Raynald Drapeau
Kapuskasing	Laurier Guillemette

Claude Richer
REPLOQ Co-ordinator

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1984 - Evaluated until 1989

The descriptive reports for the 1984 planting have already been published in the form of individual reports, illustrated with colour plates. They are available in two series – see the list of publication to find out how to obtain these reports.

Latin name	English name	French name
<i>Acer platanoides</i>	Norway Maple	Érable de Norvège, faux sycomore
<i>Acer saccharinum</i> (C)	Silver Maple, River Maple	Érable argenté, plaine blanche
<i>Cornus alba</i> 'Argenteo-marginata' ² (C)	Silver-Leaf Dogwood	Cornouiller blanc
<i>Cornus alba</i> 'Sibirica' ²	Siberian Dogwood	Cornouiller de Sibérie
<i>Cotoneaster dammeri</i> 'Coral Beauty' ²	Coral Beauty Bearberry Cotoneaster	Cotonéastre 'Coral Beauty'
<i>Euonymus alata</i> ¹	Winged Spindle Tree, Burningbush	Fusain ailé, euonymus
<i>Hydrangea paniculata</i> 'Grandiflora' ¹	Peegee Hydrangea	Hydrangée paniculée
<i>Kerria japonica</i> ¹	Japanese Rose	Keria, corète du Japon
<i>Lonicera korolkowii</i> var. <i>zabelli</i> ²	Blue-Leaf Honeysuckle	Chèvrefeuille de Zabel
<i>Lonicera morrowii</i> ²	Morrow Honeysuckle	Chèvrefeuille de Morrow
<i>Lonicera x xylosteoides</i> 'Clavey's Dwarf' ²	Clavey's Dwarf Honeysuckle	Chèvrefeuille nain 'Clavey's Dwarf'
<i>Malus baccata</i> ² (C)	Siberian Crabapple	Pometier de Sibérie, Pometier décoratif
<i>Parthenocissus quinquefolia</i> ² (C)	Virginia Creeper	Vigne vierge
<i>Paxistima canbyi</i> ¹	Paxistima	Paxistima, pachistima de Canby
<i>Physocarpus opulifolius</i> ²	Common Ninebark	Physocarbe à feuilles d'obier, Bois à sept écorces
<i>Physocarpus opulifolius</i> 'Aureus' ²	Golden Common Ninebark	Physocarbe doré à feuilles d'obier
<i>Physocarpus opulifolius</i> 'Nanus' ²	Dwarf Common Ninebark	Physocarbe nain à feuilles d'obier
<i>Potentilla fruticosa</i> 'Goldfinger' ¹	Shrubby Cinquefoil	Potentille frutescente 'Goldfinger'
<i>Prunus x cistena</i> ¹	Purple-Leaf Sand Cherry	Prunier pourpre des sables
<i>Prunus tomentosa</i> ¹	Manchu ou Nanking Cherry	Cerisier tomenteux
<i>Quercus macrocarpa</i> ¹	Bur Oak, Mossy-Cup Oak	Chêne à gros fruits
<i>Salix elaeagnos</i> ²	Eleagnus Willow, Rosemary Willow	Saule Chalef
<i>Salix purpurea</i> 'Nana' ²	Dwarf Artic Willow, Purple Willow	Saule arctique, saule pourpre nain
<i>Viburnum opulus</i> 'Compactum' ¹	Dwarf ou European Cranberry Bush	Obier nain
<i>Weigela hybrida</i> 'Bristol Ruby' ¹	Bristol Ruby Weigela	Weigela 'Bristol Ruby'

1. Species dealt with in the first series (02-9227). Available in French only.

2. Species dealt with in the second series (02-9309). Available in French only.

(C): control

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1985 - Evaluated until 1990

The descriptive reports for the 1985 planting have already been published in the book named
Hardiness and growth of woody ornamental plants in Quebec (95-0070).

Latin name	English name	French name
<i>Acer ginnala</i>	Amur Maple, Siberian Maple	Érable de l'Amur, érable de l'Amour
<i>Acer negundo</i>	Box-Elder, Ashleaf Maple	Érable à Giguère
<i>Acer saccharinum</i> (C)	Silver Maple	Érable argenté, plaine blanche
<i>Acer tataricum</i>	Tatarian Maple	Érable de Tartarie
<i>Actinidia kolomikta</i>	Actinidia	Actinidia
<i>Alnus crispa</i>	American Green Alder, Mountain Alder	Aulne crispé
<i>Alnus glutinosa</i>	European Alder, Common Alder	Aulne, verne
<i>Betula nigra</i>	River Birch	Bouleau noir ou des rivières
<i>Betula pendula</i>	European White Birch	Bouleau européen ou blanc
<i>Calluna vulgaris</i> 'Alportii'	Scotch Heather	Bruyère, callune
<i>Caragana arborescens</i>	Siberian Pea Tree	Caragana de Sibérie
<i>Caragana spinosa</i>	Peashrub	Caraganier
<i>Celtis occidentalis</i>	Common Hackberry	Micocoulier occidental
<i>Clematis virginiana</i>	Virgin's-Bower	Clématite de Virginie, herbe à gueux
<i>Cornus alba</i> 'Argenteo-marginata' (C)	Silver-Leaf Dogwood	Cornouiller blanc
<i>Corylus avellana</i> x <i>cornuta</i>	Hybrid Hazelnut	Noisetier hybride
<i>Cotoneaster dammeri</i> 'Skogholm'	Skogholm Bearberry Cotoneaster	Cotonéastre 'Skogholm'
<i>Elaeagnus angustifolia</i>	Russian Olive	Olivier de Bohême
<i>Elaeagnus commutata</i>	Silverberry, Wolf Willow	Chalef argenté
<i>Erica carnea</i> 'Praecox'	Spring Heather	Bruyère alpine
<i>Hippophae rhamnoides</i>	Sallow-Thorn, Sea-Buckthorn	Argousier faux-nerprun
<i>Juniperus conferta</i>	Shore Juniper	Genévrier du littoral
<i>Juniperus sabina</i> (C)	Savin Juniper	Sabinier, genévrier sabine
<i>Juniperus virginiana</i>	Eastern Red Cedar, Red Cedar	Genévrier de Virginie, Cèdre rouge de l'est
<i>Lonicera involucrata</i>	Bracted Honeysuckle, Twinberry	Chèvrefeuille involucre
<i>Malus baccata</i> (C)	Siberian Crabapple	Pommeter de Sibérie
<i>Myrica gale</i>	Sweet Gale	Myrique baumier
<i>Parthenocissus quinquefolia</i> (C)	Virginia Creeper	Vigne vierge
<i>Pinus nigra</i> 'Austriaca'	Austrian Pine	Pin noir d'Autriche
<i>Prunus padus</i>	European Bird Cherry	Cerisier à grappes
<i>Quercus palustris</i>	Pin Oak, Swamp Oak	Chêne des marais
<i>Quercus rubra</i>	Red Oak	Chêne rouge
<i>Rhododendron carolinianum</i> var. <i>album</i>	White Rhododendron	Rhododendron blanc
<i>Rhododendron carolinianum</i> var. <i>roseum</i>	Rose Rhododendron	Rhododendron rose
<i>Rhododendron mucronulatum</i>	Korean Rhododendron	Rhododendron de Corée
<i>Shepherdia argentea</i>	Buffaloberry	Shépherdie argentée
<i>Thuja occidentalis</i> (C)	American Arborvitae, White Cedar	Thuya occidentale, thuya du Canada
<i>Thuja occidentalis</i> 'Fastigiata'	Columnar American Arborvitae, Pyramidal Arborvitae	Thuya occidental fastigie
<i>Thuja occidentalis</i> 'Lutea'	George Peabody Arborvitae	Thuya occidental doré
<i>Thuja occidentalis</i> 'Reidii'	Reid American Arborvitae	Thuya occidental 'Reidii'
<i>Thuja occidentalis</i> 'Wareana'	Siberian Arborvitae, Siberian Cedar	Thuya de Sibérie
<i>Thuja occidentalis</i> 'Woodwardii'	Woodward American Arborvitae	Thuya occidental 'Woodwardii'
<i>Ulmus pumila</i>	Siberian Elm, Manchurian Elm	Orme de Sibérie
<i>Viburnum lantana</i>	Wayfaringtree Viburnum	Viorne commune, viorne cotonneuse
<i>Viburnum lentago</i>	Nannyberry, Sheepberry	Alisier, bourdaine
<i>Viburnum opulus</i> 'Nanum'	Dwarf European Cranberrybush	Viorne obier naine
<i>Viburnum trilobum</i>	American Cranberrybush	Viorne trilobée

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1986 - Evaluated until 1991

The descriptive reports for the 1986 planting have already been published in the book named
Hardiness and growth of woody ornamental plants in Quebec (95-0070)

Latin name	English name	French name
<i>Acer rubrum</i>	Red Maple, Swamp Maple	Érable rouge, plaine rouge
<i>Acer saccharinum</i> (C)	Silver Maple	Érable argenté, plaine blanche
<i>Aesculus hippocastanum</i>	Buckeye, Common Horsechestnut	Marronnier d'Inde
<i>Betula alleghaniensis</i>	Yellow Birch	Bouleau jaune, merisier
<i>Betula pendula</i> (origin: Russia)	European Birch	Bouleau blanc
<i>Carpinus caroliniana</i> var. <i>virginiana</i>	American Hornbeam, Blue Beech	Charme d'Amérique
<i>Cornus alba</i> 'Argenteo-marginata' (C)	Silver-Leaf Dogwood	Cornouiller blanc
<i>Cornus alba</i> 'Spaethii'	Golden Dogwood	Cornouiller de Spaeth
<i>Cornus alternifolia</i>	Dogwood Pagoda, Alternated-Leaved	Cornouiller à feuilles alternes
<i>Cornus sanguinea</i>	Bloodtwig Dogwood	Cornouiller sanguin
<i>Cornus sericea</i> 'Flaviramea'	Yellowtwig Dogwood	Cornouiller à tiges jaunes
<i>Cotoneaster apiculatus</i>	Cranberry Cotoneaster	Cotonéastre
<i>Cotoneaster horizontalis</i> var. <i>perpusillus</i>	Cotoneaster	Cotonéastre horizontal
<i>Euonymus alatus</i> 'Compactus'	Dwarf Winged Spindle	Fusain compact Burningbush
<i>Euonymus europaeus</i>	European Spindletree	Fusain d'Europe
<i>Forsythia ovata</i> 'Northern Gold'	Northern Gold Forsythia	Forsythie 'Northern Gold'
<i>Hydrangea arborescens</i> 'Annabelle'	Smooth Hydrangea	Hydrangée 'Annabelle'
<i>Juniperus chinensis</i> 'Hetzii'	Hetzii Juniper	Genévrier de Chine
<i>Larix decidua</i>	European Larch, Common Larch	Mélèze d'Europe
<i>Larix laricina</i> (C)	Eastern Larch, Tamarack	Mélèze laricin, tamarac
<i>Magnolia kobus</i>	Northern Japanese Magnolia	Magnolier
<i>Malus baccata</i> (C)	Siberian Crabapple	Pommétier de Sibérie
<i>Philadelphus x virginialis</i> 'Minnesota Snowflake'	Minnesota Snowflake Mock Snow	Séringat 'Minnesota Snowflake'
<i>Philadelphus x virginialis</i> 'Virginal'	Virginal Mock Orange	Séringat Virginal
<i>Picea pungens</i>	Colorado Spruce	Épinette du Colorado
<i>Picea pungens</i> 'Glauca'	Colorado Blue Spruce	Épinette bleue du Colorado
<i>Pinus sylvestris</i>	Scotch Pine, Scots Pine	Pin sylvestre
<i>Potentilla fruticosa</i> 'Abbotswood'	Abbotswood Cinquefoil	Potentille frutescente Abbotswood'
<i>Potentilla fruticosa</i> 'Daydawn'	Daydawn Cinquefoil	Potentille frutescente 'Daydawn'
<i>Potentilla fruticosa</i> 'Snowflake'	Snowflake Cinquefoil	Potentille frutescente 'Snowflake'
<i>Prunus tomentosa</i> (origin: Morden)	Manchu Cherry, Nanking Cherry	Cerisier tomenteux
<i>Quercus robur</i> 'Fastigiata'	Fastigate English Oak	Chêne pédonculé, chêne anglais
<i>Ribes aureum</i>	Golden Currant	Gadelier doré
<i>Ribes sanguineum</i>	Winter Currant, Flowering Currant	Groseillier sanguin, Groseillier à fleurs
<i>Rosa</i> 'Martin Frobisher'	Martin Frobisher Rose	Rosier 'Martin Frobisher'
<i>Rosa x Metis</i>	Metis Rose	Rosier 'Metis'
<i>Rosa multiflora</i>	Japanese Rose	Rosier multiflore
<i>Rosa rugosa</i> var. <i>typica</i>	Rugosa Rose, Saltspray Rough Rose	Rosier du Japon, rosier rugueux
<i>Spiraea japonica</i> 'Goldmound'	Goldmound Japanese Spirea	Spirée 'Goldmound'
<i>Spiraea nipponica</i> 'Snowmound'	Snowmound Japanese	Spirea Spirée 'Snowmound'
<i>Syringa reticulata</i>	Japanese Lilac	Lilas japonais
<i>Tamarix ramosissima</i>	Five-Stamen Tamarix, Amur Tamarix	Tamarix
<i>Thuja occidentalis</i> (C)	American Arborvitae, White Cedar	Thuya occidental
<i>Thuja occidentalis</i> 'Little Champion'	Little Champion American Arborvitae	Thuya occidental 'Little Champion'
<i>Thuja occidentalis</i> 'Pulcherrima'	Golden American Arborvitae	Thuya occidental doré
<i>Thuja occidentalis</i> 'Smaragd'	Smaragd American Arborvitae	Thuya émeraude
<i>Viburnum carlesii</i>	Koreanspice Viburnum	Viorne de Carles
<i>Viburnum opulus</i> 'Roseum'	European Snowball	Boule de neige, obier stérile
<i>Weigela florida</i> 'Variegata'	Variegata Old Fashioned Weigela	Diervillé panaché
<i>Weigela hybrida</i> 'Bristol Ruby'	Bristol Ruby Weigela	Weigela 'Bristol Ruby'

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1987 - Evaluated until 1992

The descriptive reports for the 1987 planting have already been published in the book named
Hardiness and growth of woody ornamental plants in Quebec, volume II (VR 221)

Latin Name	English Name	French Name
<i>Acer saccharinum</i> (C)	Silver Maple	Érable argenté, plaine blanche
<i>Acer tataricum</i>	Tatarian Maple	Érable de Tartarie
<i>Amelanchier alnifolia</i>	Saskatoon Serviceberry	Amélanchier à feuilles d'aulne
<i>Aronia melanocarpa</i>	Black Chokeberry	Aronia noir, gueules noires
<i>Buxus microphylla</i> var. <i>insularis</i>	Korean Boxwood	Buis coréen
<i>Caragana arborescens</i>	Siberian Pea Tree	Caragana de Sibérie
<i>Cornus alba</i> 'Elegantissima' (C)	Silver-Leaf Dogwood	Cornouiller blanc
<i>Corylus colurna</i>	Turkish Filbert, Turkish Hazelnut	Noisetier de Byzance
<i>Hypericum frondosum</i>	Golden St. Johnswort	Millepertuis doré
<i>Juniperus horizontalis</i> 'Douglasii'	Waukegan Juniper	Genévrier horizontal 'Douglasii'
<i>Juniperus x media</i> 'Pfitzeriana'	Pfitzer Juniper	Genévrier de Chine
<i>Juniperus sabina</i> (C)	Savin Juniper	Sabinier, genévrier sabine
<i>Juniperus sabina</i> 'Blue Danube' (C)	Blue Savin Juniper	Sabinier bleu
<i>Larix laricina</i> (C)	Eastern Larch, Tamarack	Mélèze laricin, tamarac
<i>Malus baccata</i> (C)	Siberian Crabapple	Pommétier de Sibérie
<i>Malus sargentii</i>	Sargent Crabapple	Pommétier de Sargent
<i>Phellodendron amurense</i>	Amur Cork Tree	Phellodendron de Chine
<i>Picea omorika</i>	Serbian Spruce	Épinette de Serbie
<i>Pinus cembra</i>	Arolla Pine, Stone Pine, Swiss Stone Pine	Pin cembro, arolle
<i>Pinus mugo</i>	Dwarf Mountain Pine	Pin des montagnes
<i>Pinus mugo</i> var. <i>pumilio</i>	Mountain Pine	Pin mugo var. <i>pumilio</i>
<i>Pinus nigra</i>	Austrian Pine	Pin noir d'Autriche
<i>Pinus peuce</i>	Balkan Pine, Macedonian Pine	Pin de Macédoine
<i>Pinus resinosa</i>	Red Pine, Norway Pine	Pin résineux, pin rouge
<i>Pinus strobus</i>	Eastern White Pine	Pin blanc
<i>Populus alba</i> 'Nivea'	Silver Poplar	Peuplier argenté
<i>Populus alba</i> 'Pyramidalis'	White Poplar	Peuplier blanc pyramidal
<i>Populus laurifolia</i>	Laurel Poplar	Peuplier à feuilles de laurier
<i>Pseudotsuga menziessi</i> ssp. <i>glauca</i>	Blue Douglas Fir	Sapin bleu de Douglas
<i>Rhododendron canadense</i> 'Albiflorum'	Rhodora	Rhododendron du Canada à fleurs blanches
<i>Rhododendron fastigiatum</i>	Autumn Purple Rhododendron	Rhododendron à feuilles pourpres
<i>Rhododendron</i> 'Ramapo'	Rhododendron	Rhododendron 'Ramapo'
<i>Ribes alpinum</i> 'Schmidt'	Schmidt Alpine Currant	Gadelier alpin 'Schmidt'
<i>Syringa vulgaris</i>	Common Lilac	Lilas des jardins
<i>Thuja occidentalis</i> (C)	American Arborvitae, White Cedar	Thuya occidentale, thuya du Canada
<i>Thuja standishii</i>	Japanese Arborvitae	Thuya du Japon
<i>Viburnum x rhytidophyloides</i> 'Alleghany'	Alleghany Lantanaphyllum Viburnum	Viorne Alleghany

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1988 - Evaluated until 1993

The descriptive reports for the 1988 planting have already been published in the book named
Hardiness and growth of woody ornamental plants in Quebec, volume II (VR 221)

Latin Name	English Name	French Name
<i>Acer platanoides</i> 'Summershade'	Summershade Norway Maple	Érable de Norvège
<i>Acer saccharinum</i> (C)	Silver Maple	Érable argenté, plaine blanche
<i>Acer saccharinum</i> 'Pyramidale'	Pyramidale Silver Maple	Érable argenté Plaine blanche pyramidale
<i>Clematis macropetala</i> 'Rosy O'Grady'	Rosy O'Grady Virgin's-Bower	Clématite des alpes 'Rosy O'Grady'
<i>Clematis tibetana</i> ssp. <i>tangutina</i>	Golden Clematis	Clématite
<i>Clematis virginiana</i> (C)	Virgin's-Bower	Clématite de Virginie
<i>Cornus alba</i> 'Gouchaultii'	Mottled Tartarian Dogwood	Cornouiller de Gouchault
<i>Cytisus decumbens</i>	Prostrate Broom	Cytise prostrée
<i>Fraxinus pennsylvanica</i>	Red Ash, Green Ash	Frêne de Pennsylvanie, frêne rouge
<i>Fraxinus pennsylvanica</i> 'Marshall Seedless'	Marshall Seedless Red Ash	Frêne rouge 'Marshall Seedless'
<i>Fraxinus pennsylvanica</i> 'Summit'	Summit Green Ash	Frêne vert
<i>Genista tinctoria</i>	Dyer's Greenweed, Woadwaxen	Genêt des teinturiers
<i>Genista tinctoria</i> var. <i>alpestris</i>	Dyer's Greenweed	Genêt des teinturiers
<i>Larix laricina</i> (C)	Eastern Larch, Common Larch	Mélèze laricin, tamarac
<i>Lonicera x brownii</i> 'Dropmore Scarlet'	Dropmore Scarlet Honeysuckle	Chèvrefeuille grim pant
<i>Mahonia aquifolium</i> 'Atropurpurea'	Oregon Holly Grape	Mahonie à feuilles de houx
<i>Malus baccata</i> (C)	Siberian Crabapple	Pommétier de Sibérie
<i>Malus baccata</i> 'Columnaris'	Columnar Siberian Crabapple	Pommétier de Sibérie colonnaire
<i>Malus</i> 'Royalty'	Royalty Crabapple	Pommétier 'Royalty'
<i>Picea abies</i>	Norway Spruce, Common Spruce	Épinette de Norvège
<i>Picea glauca</i>	White Spruce	Épinette blanche
<i>Potentilla fruticosa</i> 'Coronation Triumph'	Bush Cinquefoil	Potentille 'Coronation Triumph'
<i>Potentilla fruticosa</i> 'Maanelys'	Maanelys Shrubby Cinquefoil	Potentille frutescente Maanelys
<i>Quercus alba</i>	White Oak	Chêne blanc
<i>Rosa corymbifera</i>	Rose	Rosier
<i>Rosa corymbifera</i> 'Laxa'	Rose	Rosier du Turkestan
<i>Rosa glauca</i>	Purple Leaf Rose	Rosier à feuilles pourpres
<i>Rosa maximowicziana</i>	Maximowicziana Rose	Rosier
<i>Rosa pimpinellifolia</i> 'Grandiflora'	Altai Scotch Rose	Rosier d'Altai, rosier d'Écosse
<i>Rosa pimpinellifolia</i> 'Maigold'	Maigold Scotch Rose, Burnet Rose	Rosier épineux 'Maigold'
<i>Rosa</i> 'Alexander Mackenzie'	Alexander Mackenzie Rose	Rosier 'Alexander Mackenzie'
<i>Rosa</i> 'Hansa'	Hansa Rose	Rosier 'Hansa'
<i>Rosa</i> 'F.J. Grootendorst'	Nelkenrose Rose, F.J. Grootendorst Rough Rose	Rosier à fleurs d'œillet
<i>Rosa</i> 'Prairie Youth'	Prairie Youth Rosa	Rosier 'Prairie Youth'
<i>Rosa</i> 'William Baffin'	William Baffin Rose	Rosier 'William Baffin'
<i>Thuja occidentalis</i> (C)	American Arborvitae, White Cedar	Thuya occidental

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1989 - Evaluated until 1994

The descriptive reports for the 1989 planting have already been published in the book named
Hardiness and growth of woody ornamental plants in Quebec, volume III (VT 008)

Latin Name	English Name	French Name
<i>Acer ginnala</i> (dark pink)	Amur Maple	Érable de l'Amour
<i>Acer platanoides</i> 'Emerald Queen'	Emerald Queen Maple	Érable de Norvège 'Emerald Queen'
<i>Acer saccharum</i> (Morden)	Sugar Maple	Érable à sucre
<i>Acer saccharinum</i> (C) 89	Silver Maple	Érable argenté
<i>Acer saccharinum</i> 'Wieri'	Wieri Silver Maple	Érable argenté 'Wieri'
<i>Amelanchier bartromiana</i>	Shadbush	Amélanchier
<i>Amelanchier stolonifera</i>	Running Serviceberry	Amélanchier
<i>Chamaecyparis pisifera</i>	Japanese False Cypress	Faux-cyprès de Sawara ou
	Sawara <i>Chamaecyparis</i>	<i>Chamaecyparis</i> à pois
<i>Chamaecyparis pisifera</i> 'Filifera'	Tread-Leaf False Cypress	Faux-cyprès de Sawara
<i>Chamaecyparis pisifera</i> 'Filifera Nana'	Swarf-Leaf False Cypress	Faux-cyprès de Sawara nain
<i>Chamaecyparis pisifera</i> 'Gold Spangle'	Thread-Leaf False Cypress	Faux-cyprès de Sawara 'Gold Spangle'
<i>Cotoneaster hupehensis</i>	Hupei Cotoneaster	Cotonéastre de Hupei
<i>Forsythia mandshurica</i>	Manchurian Forsythia,	Forsythia de Mandchourie
	Vermont Sun	
<i>Juniperus x media</i> 'Mint Julep'	'Mint Julep' Juniper,	Genévrier de Chine 'Mint Julep'
	Sea Green Juniper	
<i>Larix laricina</i> (C)	Eastern Larch, Tamarack	Mélèze laricin, tamarac
<i>Lonicera x xylostevoides</i> 'Mini-globe'	'Miniglobe' Honeysuckle	Chèvrefeuille 'Miniglobe'
<i>Maackia amurensis</i>	Amur Maackia	Maackie de l'Amur
<i>Malus baccata</i> (C)	Siberian Crabapple	Pommétier de Sibérie
<i>Physocarpus opulifolius</i> 'Dart's Gold'	Dart's Gold Ninebark	Physocarbe 'Dart's Gold'
<i>Prunus nipponica</i> var. <i>kurilensis</i>	Kurile Cherry	Cerisier kurile
<i>Prunus spinosa</i> 'Purpurea'	Blackthorn	Prunier à feuillage pourpre
<i>Quercus alba</i>	White Oak	Chêne blanc
<i>Rosa beggeriana</i>	Rosa	Rosier
<i>Rosa</i> 'David Thompson'	David Thompson Rose	Rosier 'David Thompson'
<i>Rosa</i> 'John Cabot'	John Cabot Rose	Rosier 'John Cabot'
<i>Rosa</i> 'William Baffin'	William Baffin Rose	Rosier 'William Baffin'
<i>Salix x</i> 'Prairie Cascade'	Weeping White Willow,	Saule pleureur 'Prairie Cascade'
	Prairie Cascade	
<i>Sorbaria sorbifolia</i>	Ural False Spirea	Sorbaria à feuilles de sorbier, fausse spirée
<i>Spiraea x billardii</i>	Billard Spirea	Spirée
<i>Spiraea japonica</i> 'Little Princess'	Little Princess Spirea	Spirée 'Little Princess'
<i>Taxus x media</i>	Anglo-Japanese Yew	If
<i>Thuja occidentalis</i> (C)	American Arborvitae	Thuya occidentale
<i>Weigela</i> 'Styriaca'	Styriaca Weigela	Weigela 'Styriaca'
<i>Weigela x</i> 'Rosabella'	Rosabella Weigela	Weigela 'Rosabella'

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1990 - Evaluated until 1995

The descriptive reports for the 1989 planting have already been published in the book named
Hardiness and growth of woody ornamental plants in Quebec, volume III (VT 008)

Latin name	English name	French name
<i>Acer pseudoplatanus</i> 'Atropurpureum'	Spaethii Sycamore Maple	Érable sycomore à feuilles pourpres
<i>Acer saccharinum</i> (C)	Silver Maple	Érable argenté
<i>Acer saccharinum</i> (La Pocatière)	Silver Maple	Érable argenté
<i>Aesculus glabra</i>	Ohio Buckeye	Marronnier de l'Ohio
<i>Betula nana</i>	Dwarf Birch	Bouleau nain
<i>Betula platyphylla</i> var. <i>japonica</i>	Japanese White Birch	Bouleau blanc du Japon
<i>Callicarpa dichotoma</i>	Beauty Berry	Callicarpa
<i>Calluna vulgaris</i> 'Martha Herman'	Martha Herman Scotch Heather	Calluna 'Martha Herman'
<i>Calluna vulgaris</i> 'Peter Sparkes'	Peter Sparkes Scotch Heather	Calluna 'Peter Sparkes'
<i>Cornus alba</i> 'Argenteo-marginata'	Tatarian Dogwood	Cornouiller blanc
<i>Cornus racemosa</i>	Panicked Dogwood	Cornouiller à grappes
<i>Cotoneaster melanocarpus</i>	Cotoneaster	Cotonéastre à fruits noirs
<i>Erica darleyensis</i> 'Pirbright'	Pirbright Spring Heather	Bruyère 'Pirbright'
<i>Erica darleyensis</i> 'Silberschmelze'	Silberschmelze Spring Heather	Bruyère 'Silberschmelze'
<i>Gymnocladus dioica</i>	Kentucky Coffeetree	Chicot du Canada, arbre à café
<i>Kolkwitzia amabilis</i>	Beauty Bush	Kolkwitzia
<i>Lonicera caerulea</i> var. <i>dependens</i>	Bear Berry Honeysuckle	Chèvrefeuille
<i>Lonicera xylosteum</i>	European Fly Honeysuckle	Chèvrefeuille d'Europe
<i>Neillia ueckii</i>	Neillia	Neillie
<i>Malus baccata</i> (C)	Siberian Crabapple	Pommetier de Sibérie
<i>Malus hupehensis</i>	Tea Crabapple	Pommetier de Hupeh
<i>Malus</i> 'Radiant'	Radiant Crabapple	Pommetier 'Radiant'
<i>Populus alba</i> 'Raket'	Bolleana Poplar	Peuplier
<i>Rhododendron viscosum</i>	Swamp Azalea	Rhododendron des marais
<i>Rosa</i> 'Champlain'	Champlain Rosa	Rosier 'Champlain'
<i>Rosa</i> 'Henry Kelsey'	Rosier 'Henry Kelsey'	Henry Kelsey Rosa
<i>Rosa rugosa</i> 'Blanc Double de Coubert'	Blanc Double de Coubert Rough Rosa	Rosier rugueux 'Blanc Double de Coubert'
<i>Rhus aromatica</i>	Fragrant Sumac	Sumac aromatique
<i>Staphylea bumalda</i>	Bladder Nut	Staphyllier
<i>Stephanandra incisa</i>	Cut Leaf Stephanandra	Stéphanandra
<i>Stephanandra incisa</i> 'Crispa Nana'	Dwarf Cut Leaf Stephanandra	Stéphanandra nain
<i>Thuja occidentalis</i> (C)	American Arborvitea	Thuya occidental
<i>Thuja occidentalis</i> 'Boisbriand'	Boisbriand American Arborvitea	Thuya occidental 'Boisbriand'
<i>Thuja occidentalis</i> 'Ellwangeriana Aurea'	Ellwangeriana Aurea American Arborvitea	Thuya occidental 'Ellwangeriana Aurea'
<i>Thuja occidentalis</i> 'Ellwangeriana'	Ellwangeriana American Arborvitea	Thuya occidental 'Ellwangeriana'
<i>Tsuga canadensis</i>	Eastern Hemlock, Canadian Hemlock	Pruche de l'est, tsuga du Canada
<i>Viburnum dentatum</i>	Arrow Wood Viburnum	Viorne dentée
<i>Viburnum trilobum</i> 'Nanum'	Dwarf Wood Viburnum	Viorne trilobée naine
<i>Weigela</i> 'Candida'	Candida Weigela	Weigela 'Candida'
<i>Weigela</i> 'Rumba'	Rumba Weigela	Weigela 'Rumba'

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1991 - Evaluated until 1996

Latin name	English name	French name
<i>Acer saccharinum</i> L. (C)	Silver Maple	Érable argenté
<i>Acer spicatum</i> Lam.	Mountain Maple	Érable à épis, plaine bâtarde
<i>Aesculus hippocastanum</i> L.	Common Horse Chestnut	Marronnier d'Inde, châtaignier des chevaux, bois de Spa
<i>Buxus microphylla</i> 'Green Gem'	Green Gem Little Leaf Boxwood	Buis à petites feuilles 'Green Gem'
<i>Buxus microphylla</i> 'Green Mound'	Green Mound Little Leaf Boxwood	Buis à petites feuilles 'Green Mound'
<i>Buxus microphylla</i> 'Green Mountain'	Green Mountain Little Leaf Boxwood	Buis à petites feuilles 'Green Mountain'
<i>Cornus alba</i> 'Argenteo-marginata' (C)	Tatarian Dogwood	Cornouiller blanc
<i>Cotoneaster acutifolius</i> Turcz.	Peking Cotoneaster	Cotonéastre de Pékin
<i>Cotoneaster horizontalis</i> Decne.	Rock Cotoneaster	Cotonéastre des rochers
<i>Crataegus crus-galli</i> L.	Cockspur Hawthorn	Aubépine ergot-de-coq
<i>Daphne cneorum</i> Pall.	Garland Flower Daphne	Daphné odorant
<i>Gleditsia triacanthos inermis</i> (L.) Zabel.	Thornless Honeylocust	Févier inermis d'Amérique
<i>Hydrangea quercifolia</i> Bartr.	Oakleaf Hydrangea	Hydrangée à feuilles de chêne
<i>Juniperus sabina</i> 'Blue Danube' (C)	Blue Danube Savin Juniper	Sabinier 'Blue Danube'
<i>Juniperus sabina</i> 'Broadmoor'	Broadmoor Juniper, Broadmoor Savin Juniper	Sabinier 'Broadmoor', Genévrier 'Broadmoor'
<i>Malus baccata</i> (L.) Borkh. (C)	Siberian Crabapple	Pommétier de Sibérie
<i>Philadelphus coronarius</i> 'Aureus'	Golden Mock Orange	Séringat doré
<i>Potentilla fruticosa</i> 'Goldstar'	Gold Star Cinquefoil	Potentille frutescente 'Gold Star'
<i>Potentilla fruticosa</i> 'McKay's White'	McKay's White Cinquefoil	Potentille frutescente 'McKay's White'
<i>Prunus besseyi</i> L.H. Bailey	Sand Cherry	Cerisier des sables
<i>Rosa</i> 'John Davis'	John Davis Rose	Rosier 'John Davis'
<i>Rosa</i> 'J.P. Connell'	J.P. Connell Rose	Rosier 'J.P. Connell'
<i>Rosa pimpinellifolia</i> var. <i>Frühlingsduft</i>	Scotch Rose	Rosier 'Frühlingsduft'
<i>Rosa rugosa</i> 'L' Assomption'	L' Assomption Rough Rosa	Rosier rugeux 'L' Assomption'
<i>Spiraea japonica</i> 'Flaming Mound'	Flaming Mound Japanese Spirea	Spirée japonaise 'Flaming Mound'
<i>Spiraea trichocarpa</i> 'Snow White'	Snow White Spirea	Spirée 'Snow White'
<i>Syringa meyeri</i> 'Palibin'	Palibin Lilac, Dwarf Korean Lilac	Lilas de Mandchourie, lilas coréen
<i>Taxus cuspidata</i> Siebold & Zucc.	Japanese Yew	If du Japon
<i>Thuja occidentalis</i> L. (C)	American Arborvitea	Thuja occidentale
<i>Thuja occidentalis</i> 'Cloth of Gold'	Cloth of Gold American Arborvitea	Thuja occidentale 'Cloth of Gold'
<i>Thuja occidentalis</i> 'Globosa Aurea'	Globosa Aurea American Arborvitea	Thuja occidentale 'Globosa Aurea'
<i>Thuja occidentalis</i> 'Holmstrump'	Holmstrump American Arborvitea	Thuja occidentale 'Holmstrump'
<i>Thuja occidentalis</i> 'Lutescens'	Lutescens American Arborvitea	Thuja occidentale 'Lutescens'
<i>Thuja occidentalis</i> 'Mastersii'	Mastersii American Arborvitea	Thuja occidentale 'Mastersii'
<i>Tilia cordata</i> Mill.	Small-Leaved European Linden	Tilleul à petites feuilles Tilleul des bois
<i>Tilia japonica</i> (Miq.) Simonkai	Japanese Linden	Tilleul japonais
<i>Ulmus rubra</i> Muhlenb.	Slippery Elm, Red Elm	Orme rouge
<i>Weigela</i> 'Minuet'	Minuet Weigela	Weigela 'Minuet'

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ IN CHRONOLOGICAL ORDER OF PLANTING

Introduced in 1992 - Evaluated until 1997

Latin name	English name	French name
<i>Abies concolor</i> (Gord.) Lindl. ex Hildebr.	White Fir	Sapin du Colorado
<i>Acer saccharinum</i> L. (C)	Silver Maple	Érable argenté
<i>Amorpha fruticosa</i> L.	Indigobush Amorpha, False Indigo	Amorpha, faux indigo
<i>Amorpha fruticosa</i> var. <i>tenessensis</i> (Shuttlew.)	Bastard Indigo	Amorpha
<i>Aronia arbutifolia</i> (L.) Pers.	Red Chokeberry	Aronia
<i>Betula tianschanica</i> Rupr.	Tien'Chan Mountain Birch	Bouleau des Monts Tien'Chan
<i>Calluna vulgaris</i> 'Golden Carpet'	Golden Carpet Heather	Bruyère 'Golden Carpet'
<i>Cercidiphyllum japonicum</i> Siebold & Zucc. ex J. Hoffm. & H. Schult.	Katsura Tree	Arbre de Katsura
<i>Chamaecyparis lawsoniana</i> (A. Murr.) Parl.	False Cypress	Cyprès
<i>Cornus alba</i> 'Argenteo-marginata' (C)	Tatarian Dogwood	Cornouiller blanc
<i>Crataegus basilica</i>	Magnificent Thorn	Aubépine magnifique
<i>Crataegus coccinea</i> L.	Scarlet Thorn	Aubépine écarlate
<i>Crataegus submollis</i> Sarg.	Downy Hawthorn, Quebec Hawthorn	Aubépine duvetueuse ou Aubépine du Québec
<i>Forsythia x ovata</i> 'Happy Centennial'	Happy Centennial Forsythia	Forsythie 'Happy Centennial'
<i>Ilex x meseruae</i> 'Blue Prince'	Blue Prince Holly	Houx hybride 'Blue Prince'
<i>Ilex x meseruae</i> 'Blue Princess'	Blue Princess Holly	Houx hybride 'Blue Princess'
<i>Juniperus communis</i> 'Rependa'	Rependa Juniper	Genévrier commun rampant
<i>Juniperus sabina</i> 'Blue Danube' (C)	Blue Danube Savin Juniper	Sabinier 'Blue Danube'
<i>Juniperus scopulorum</i> 'Blue Haven'	Bleu Haven Juniper	Genévrier des Rocheuses 'Blue Haven'
<i>Larix kaempferi</i> (Lamb.) Carr.	Japanese Larch	Mélèze du Japon
<i>Larix laricina</i> (Du Roi) K. Koch. (C)	American Larch, Tamarack	Mélèze laricin, tamarac
<i>Ligustrum x vicaryi</i> Rehd.	Golden Vicary Privet	Troène doré
<i>Lonicera webbiana</i> Wall.	Honeysuckle	Chèvrefeuille d'Asie
<i>Malus baccata</i> (L.) Borkh. (C)	Siberian Crabapple	Pommetier de Sibérie
<i>Picea abies</i> 'Nidiformis'	Nidiformis Norway Spruce, Bird's Nest Spruce	Épinette de Norvège 'Nidiformis'
<i>Pinus aristata</i> Engelm.	Bristle Cone Pine	Pin à cônes épineux
<i>Populus x canescens</i> 'Tower'	Tower Poplar	Peuplier 'Tower'
<i>Rhododendron canadense</i> (L.) Torr.	Canadense Rhodora	Rhododendron du Canada
<i>Rhododendron molle</i> (Blume.) G. Don.	Rhododendron, Azalea Molle	Rhododendron molle
<i>Rhododendron</i> 'Ramapo'	Ramapo Rhododendron	Rhododendron 'Ramapo'
<i>Rhododendron vaseyi</i> A. Gray.	Pink Shell Azalea	Rhododendron vaseyi
<i>Rosa</i> 'Louis Jolliet'	Louis Jolliet Rose	Rosier 'Louis Jolliet'
<i>Spiraea japonica</i> 'Shirobana'	Shirobana Spirea	Spirée 'Shirobana'
<i>Thuja occidentalis</i> L. (C)	American Arborvitea	Thuya occidentale
<i>Tilia cordata</i> 'Greenspire'	Greenspire Linden	Tilleul 'Greenspire'
<i>Tilia x 'Flavescens</i> Glenleven'	Flavescens Glenleven Linden	Tilleul 'Flavescens Glenleven'
<i>Weigela florida</i> 'Nana Purpurea'	Nana Purpurea Weigela	Weigela 'Nana Purpurea'
<i>Weigela</i> 'Java Red'	Java Red Weigela	Weigela 'Java Red'
<i>Weigela</i> 'Red Prince'	Red Prince Weigela	Weigela 'Red Prince'
<i>Weigela</i> 'Samba'	Samba Weigela	Weigela 'Samba'

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REFLOQ FROM 1991 TO 1992 IN ALPHABETICAL ORDER

A

Abies concolor (Gord.) Lindl. ex Hildebr.
Acer saccharinum L. (C)
Acer spicatum Lam.
Aesculus hippocastanum L.
Amorpha fruticosa L.
Amorpha fruticosa var. *tenessensis* (Shuttlew.)
Aronia arbutifolia (L.) Pers.

B

Betula tianschanica Rupr.
Buxus microphylla 'Green Gem'
Buxus microphylla 'Green Mound'
Buxus microphylla 'Green Mountain'

C

Calluna vulgaris 'Golden Carpet'
Cercidiphyllum japonicum Siebold & Zucc. ex J. Hoffm. & H. Schult.
Chamaecyparis lawsoniana (A. Murr.) Parl.
Cornus alba 'Argenteo-marginata' (C)
Cotoneaster acutifolius Turcz.
Cotoneaster horizontalis Decne.
Crataegus basilica
Crataegus coccinea L.
Crataegus crus-galli L.
Crataegus submollis Sarg.

D

Daphne cneorum Pall.

F

Forsythia x ovata 'Happy Centennial'

G

Gleditsia triacanthos inermis (L.) Zabel.

H

Hydrangea quercifolia Bartr.

I

Ilex x meseroae 'Blue Prince'
Ilex x meseroae 'Blue Princess'

J

Juniperus communis 'Rependa'
Juniperus sabina 'Blue Danube' (C)
Juniperus sabina 'Broadmoor'
Juniperus scopulorum 'Blue Haven'

L

Larix kaempferi (Lamb.) Carr.
Larix laricina (Du Roi) K. Koch. (C)

Ligustrum x vicaryi Rehd.
Lonicera webbiana Wall.

M

Malus baccata (L.) Borkh. (C)

P

Philadelphus coronarius 'Aureus'
Picea abies 'Nidiformis'
Pinus aristata Engelm.
Populus x canescens 'Tower'
Potentilla fruticosa 'Goldstar'
Potentilla fruticosa 'McKay's White'
Prunus besseyi L.H. Bailey

R

Rhododendron canadense (L.) Torr.
Rhododendron molle (Blume) G. Don.
Rhododendron 'Ramapo'
Rhododendron vaseyi A. Gray.
Rosa 'John Davis'
Rosa 'J.P. Connell'
Rosa 'Louis Jolliet'
Rosa pimpinellifolia var. *Frühlingsduft*
Rosa rugosa 'L' Assomption'

S

Spiraea japonica 'Flaming Mound'
Spiraea japonica 'Shirobana'
Spiraea trichocarpa 'Snow White'
Syringa meyeri 'Palibin'

T

Taxus cuspidata Siebold & Zucc.
Thuja occidentalis L. (C)
Thuja occidentalis 'Cloth of Gold'
Thuja occidentalis 'Globosa Aurea'
Thuja occidentalis 'Holmstrup'
Thuja occidentalis 'Lutescens'
Thuja occidentalis 'Mastersii'
Tilia cordata Mill.
Tilia cordata 'Greenspire'
Tilia x 'Flavescens Glenleven'
Tilia japonica (Miq.) Simonkai

U

Ulmus rubra Muhlenb.

W

Weigela florida 'Nana Purpurea'
Weigela 'Java Red'
Weigela 'Minuet'
Weigela 'Red Prince'
Weigela 'Samba'

LIST OF ORNAMENTAL WOODY PLANTS TESTED BY REPLOQ FROM 1991 TO 1992 BY WOODY PLANT CATEGORY

LARGE DECIDUOUS TREES

Acer saccharinum L. (C)
Aesculus hippocastanum L.
Betula tianschanica Rupr.
Cercidiphyllum japonicum Siebold & Zucc. ex J. Hoffm.
 & H. Schult.
Gleditsia triacanthos inermis (L.) Zabel.
Populus x canescens 'Tower'
Tilia cordata Mill.
Tilia cordata 'Greenspire'
Tilia x Flavescens Glenleven'
Tilia japonica (Miq.) Simonkai
Ulmus rubra Muhlenb.

SMALL DECIDUOUS TREES

Acer spicatum Lam.
Crataegus basilica
Crataegus coccinea L.
Crataegus crus-galli L.
Crataegus submollis Sarg.
Malus baccata (L.) Borkh. (C)

SHRUBS

Amorpha fruticosa L.
Amorpha fruticosa var. *tenessensis* (Shuttlew.)
Aronia arbutifolia (L.) Pers.
Buxus microphylla 'Green Gem'
Buxus microphylla 'Green Mound'
Buxus microphylla 'Green Mountain'
Cornus alba 'Argenteo-marginata' (C)
Cotoneaster acutifolius Turcz.
Cotoneaster horizontalis Decne.
Daphne cneorum Pall.
Forsythia x ovata 'Happy Centennial'
Hydrangea quercifolia Bartr.
Ilex x meserveae 'Blue Prince'
Ilex x meserveae 'Blue Princess'
Ligustrum x vicaryi Rehd.
Lonicera webbiana Wall.
Philadelphus coronarius 'Aureus'
Potentilla fruticosa 'Goldstar'
Potentilla fruticosa 'McKay's White'
Prunus besseyi L.H. Bailey.

Rosa 'John Davis'
Rosa 'J.P. Connell'
Rosa 'Louis Jolliet'
Rosa pimpinellifolia var. *Frühlingsduft*
Rosa rugosa 'L' Assomption'
Spiraea japonica 'Flaming Mound'
Spiraea japonica 'Shirobana'
Spiraea trichocarpa 'Snow White'
Syringa meyeri 'Palibin'
Weigela florida 'Nana Purpurea'
Weigela 'Java Red'
Weigela 'Minuet'
Weigela 'Red Prince'
Weigela 'Samba'

EVERGREENS

Abies concolor (Gord.) Lindl. ex Hildebr.
Chamaecyparis lawsoniana (A. Murr.) Parl.
Juniperus communis 'Rependa'
Juniperus sabina 'Blue Danube' (C)
Juniperus sabina 'Broadmoor'
Juniperus scopulorum 'Blue Haven'
Larix kaempferi (Lamb.) Carr.
Larix laricina (Du Roi) K. Koch. (C)
Picea abies 'Nidiformis'
Pinus aristata Engelm.
Taxus cuspidata Siebold & Zucc.
Thuja occidentalis L. (C)
Thuja occidentalis 'Cloth of Gold'
Thuja occidentalis 'Globosa Aurea'
Thuja occidentalis 'Holmstrup'
Thuja occidentalis 'Lutescens'
Thuja occidentalis 'Mastersii'

ERICACEAE

Calluna vulgaris 'Golden Carpet'
Rhododendron canadense (L.) Torr.
Rhododendron molle (Blume) G. Don.
Rhododendron 'Ramapo'
Rhododendron vaseyi A. Gray.

ABIES CONCOLOR

(GORD.) LINDL. EX HILDEBR.

Family:	Pinaceae
English name:	White Fir
French name:	Sapin du Colorado
Category:	Evergreen plant.
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This large conifer has a conical shape and can reach a height of 30 m and a spread of 6 m in the wild. It generally does not grow taller than 15 m in Quebec gardens.

The smooth, grey bark of young branchlets is thin and covered with resin blisters. With time, the bark thickens and becomes scaly and furrowed.

Whereas the branches in the crown point upwards and the central branches spread horizontally, the lower branches bend towards the ground. The robust branchlets, which are more or less breakable, bear rounded buds that are typically covered with resin. Young shoots are covered with minute silky hairs.

The flattened needles, 4 to 6 cm long, curve upwards from the stem and are soft to the touch. They spread horizontally in two distinct ranks on the branches. The needles range in colour from glaucous on the upper surface to a bright silvery blue on the underside. They emit a pleasant odour.

Mature white firs have erect, cylindrical female cones growing primarily on the highest branches. They are reddish purple in spring, pale green in early summer and brown in late fall at maturity. Although the mature cones break up and shed their scales, the bare rachis stays on the tree until the following summer. The cones are 7 to 12 cm long. Older white firs have grey-violet or yellow cones.

The root system consists of a shallow tap root with a network of wide-spreading lateral roots.

ORIGIN AND DISTRIBUTION

This species is native to the western United States, and ranges from Colorado to southern California and from northern Mexico and New Mexico to the Rocky Mountains.

USE

Ornamental: This species is used as a specimen tree in large areas and sometimes in mass plantings because of its attractive needles. *Abies concolor* graces a number of urban gardens and parks, being fairly tolerant of city conditions.

Aromatherapy: Oils extracted from the needles are used in the preparation of various remedies.

REQUIREMENTS

This species grows best on rich, moist soils with a neutral pH. Although white firs adapt well to most soil types, they dislike calcareous soils. They are drought resistant and tolerant of slightly moist environments. The species prefers full sun but will tolerate partial shade. Planting sites sheltered from the prevailing winds are recommended to avoid winter dehydration.

Pruning is useful to obtain denser trees.

The species does not transplant well as it ages. Though hardy, it requires good winter protection during the first few years after planting.

DISEASES AND INSECTS

Cytospora canker of spruce (*Cytospora kunzei*), a fungal disease, can affect *Abies concolor*.

White fir is also subject to aphid damage.

PROPAGATION

Seeds: Seeds are the main propagation method for this species. The germination rate is about 35 % to 40 %. The seeds are collected and sown in autumn. They can

conserve their germination capacity for years if stored at -5 to -15 °C.

Grafting: Cultivars are usually grafted by inarching or approach grafting, which involves choosing the shoots closest to the main axis of the parent plant as scions.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: The seeds were collected in fall 1987 from parent plants that were about 20 years old. They were sown in an outdoor cold frame at the end of March 1988. In August 1990, 220 seedlings were potted in Fertil Pot® containers and returned to the cold frame until it was time for shipping. Every winter, they were protected in cold frames with a plywood covering. The survival rate was 100 %. In summer, they received weekly applications of soluble fertilizer (20-20-20 with 400 ppm nitrogen). They were packed and shipped on May 5, 1992.

Inclusion in testing network: Young shoots 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario. Their winter survival and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed over a five-year period. Details are provided below on the main types of damage that occurred each winter at the different sites.

Region 1

At L'Assomption, one seedling died during the third winter. Foliage browning was observed on 5 %, 8 % and 73 % of the trees during the first, third and fourth winters.

At Sainte-Clotilde, heavy mortality occurred in the third winter as a result of frost heaving, with only four plants surviving. One of these suffered foliage browning in the fourth winter.

At Saint-Hyacinthe, three, five and nine trees died during the first three winters and four survived. No frost damage was subsequently observed in the surviving trees.

Region 2

At Sainte-Foy, one seedling died during the first winter. After that, the only damage observed was foliage browning in the last two winters, affecting 50 % and 33 % of the trees.

At Deschambault, one seedling died during the first winter. Foliage browning occurred in 20 %, 8 % and 8 % of the trees during the second, fourth and fifth winters. In addition, one tree was affected by breakage in the last winter.

At La Pocatière, damage was recorded only during the second winter, with 24 % of the seedlings suffering frost injury on the aerial shoots that emerged above the snow cover, 50 % foliage browning and 5 % frost damage on the stem tips.

Region 3

At Normandin, six seedlings died during the first winter. After that, foliage browning was the only damage observed, with 40 % and 10 % of seedlings being affected during the last two winters.

At Kapuskasing, seedling mortality totalled 15, 5 and 1 in the first, third and fourth winters. The surviving trees suffered frost damage on the year-old shoot or on the stem tips in the first two winters.

Growth in height and width

Figures 1 and 2 show the average height and width of the trees after five years of testing at each site in the different regions.

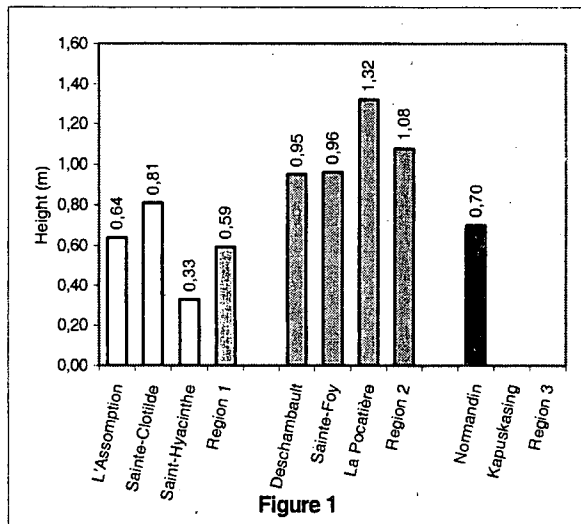


Figure 1. Average height of the trees at test completion for the eight sites and the three regions

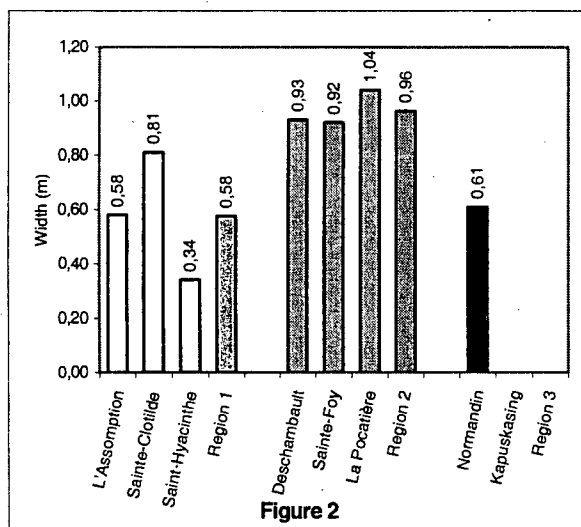


Figure 2. Average width of the trees at test completion for the eight sites and the tree regions

The widths were especially homogeneous within the sites in region 2. The trees at Saint-Hyacinthe and Kapuskasing were evaluated for only four years and are not included in the respective regional averages.

Effect of pruning

No pruning was done during the testing period except on the seedlings at Normandin, which underwent light pruning in the last two years.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year according to final height and width classes. Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

Production of this species can be considered marginal in Quebec, because of its slow growth rate and the high mortality observed during the first few years among young trees at the two sites in the Montreal area and at Kapuskasing.

From seed, it took more than eight years to obtain trees taller than 51 cm at the three sites in region 2 and at Normandin. It took an additional year to obtain trees of comparable height at the L'Assomption and Sainte-Clotilde sites.

HARDINESS EVALUATION

According to the literature, this species' hardiness places it in zone 4. The test results show that this species can survive as far as north as zone 2b, but mortality is excessive in zone 2a. However, the trees did not emerge from the snow cover during the testing period in this borderline zone. Furthermore, the species showed difficulty recovery from transplanting and was fragile during the first few years of growth.

The species can be used as far north as zone 2b but only young seedlings will survive. In zone 4, the stem tips emerge above the snow cover but the trees can still survive.

The species did not achieve its potential for full ornamental expression at the test sites and this potential extends beyond the zones tested. Magnificent specimens can, however, be found in zones 4a (Lower St. Lawrence), 4b (Quebec City) and 5b (Montreal). It therefore appears that the seedlings that survive transplanting and adapt to their

new environment can develop normally, achieving an attractive shape and steady growth.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 9, 17, 28, 31, 32, 33, 35, 39

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Table 1. Frequency of winter damage observed on *Abies concolor* (Gord.) Lindl. ex Hildebr. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	6	7	8	10	11	14	
REGION 1											
L'Assomption	81						2			17	19
Sainte-Clotilde	76						19			5	24
Saint-Hyacinthe	73						26	1			27
REGION 2											
Deschambault	90						1	2		7	10
Sainte-Foy	82						1			17	18
La Pocatière	85		1			5				9	15
REGION 3											
Normandin	84						6			10	16
Kapuskasing	30		5		1		64				70

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Abies concolor* (Gord.) Lindl. ex Hildebr. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	100	100	73	18	100	100	100	50	25	100	100	100	100	-
051-100	0	0	0	27	82	0	0	0	50	75	-	-	-	-	-
101-150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	95	92	8	0	100	100	67	17	0	100	95	24	8	0
051-100	0	5	8	92	50	0	0	33	83	67	0	5	76	67	0
101-150	0	0	0	0	50	0	0	0	0	33	0	0	0	25	55
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	45
REGION 3															
Height (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	87	90	20	0	100	100	100	100	-					
051-100	0	13	10	80	100	-	-	-	-	-					
101-150	-	-	-	-	-	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*At Saint-Hyacinthe and Kapuskasing, all plants were dead the fourth winter.

Table 3. Breakdown of *Abies concolor* (Gord.) Lindl. ex Hildebr. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	100	27	9	100	100	80	0	0	100	100	100	100	-
041-080	0	0	0	73	91	0	0	20	100	50	-	-	-	-	-
081-120	-	-	-	-	-	0	0	0	0	50	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	80	0	0	0	100	100	33	0	0	100	95	8	8	0
041-080	0	20	100	83	8	0	0	67	75	17	0	5	92	58	0
081-120	0	0	0	17	92	0	0	0	25	83	0	0	0	34	100
REGION 3															
Width (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	100	40	10	10	100	100	100	100	-					
041-080	0	0	60	90	90	-	-	-	-	-					
081-120	-	-	-	-	-	-	-	-	-	-					

*At Saint-Hyacinthe and Kapuskasing, all plants were dead the fourth winter.

ACER SACCHARINUM

L. (CONTROL 1991)

The sections Botanical Description, Origin and Distribution, Use and Requirements can be found in the first series of fact sheets (02-9227).

DISEASES AND INSECTS

Anthrachnose (*Gloeosporium* sp.), eutypella canker (*Eutypella parasitica*) and septoria spot (*Septoria* sp.) are fungal diseases that may strike maples during periods favourable to the development of disease or after breaks or mechanical injury. In general, maples are susceptible to scale insects, including the oystershell scale (*Lepidosaphes ulmi*), cottony maple scale and lecanium scale.

Foliage damage may also be caused by leafhoppers. Japanese Beetles (*Popillia japonica*) attack the aerial portion of the plant. This insect occurs in southwestern Quebec and the Richelieu Valley.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, La Pocatière (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds were harvested in early June 1989 from a 35-year-old parent plant measuring 15 m high, with a 30-cm-diameter trunk. On June 22, the seeds were received and sown in a cold frame in a Promix®-sand mixture (1:2; v:v), shaded by a cloth (63 %). Planting depth was 10 mm. They were watered for one hour a day during the growing season, except on rainy days. Emergence occurred over roughly ten days. Average height growth during the first season was 15-20 cm. The seedlings were dug up in mid-October and heeled in for the winter. On May 24, 1990, 512 seedlings were transplanted to the

nursery, where they were grown until fall. On October 23, they were again dug up, puddled and heeled in until the spring of 1991. The winter survival rate was 100 %. On April 17, they were wrapped and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Seedlings 45-60 cm high and 8 mm in diameter were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 100 % and 33 % of the seedlings had frost damage to the branch tips the first two winters. No other damage was observed.

At Sainte-Clotilde, one tree suffered damage to the previous year's shoots the second winter. Frost damage to the branch tips occurred in 15 % of seedlings the fifth winter. No other damage occurred.

At Saint-Hyacinthe, no damage was observed during the five years of the trial.

Region 2

At Deschambault, frost damage to the branch tips occurred the first three winters, while damage to the old wood was observed after each of the first two winters.

At Sainte-Foy, frost damage to the branch tips occurred the first four winters. The second winter, seedlings suffered frost damage to the previous year's shoots. No damage occurred the last winter.

At La Pocatière, 50-80 % of trees suffered frost damage to the branch tips the first three winters. No other damage was observed. Extensive wilting was observed the third summer due to a drought.

Region 3

At Normandin, all seedlings suffered frost damage to the branch tips the first three winters. No subsequent damage was observed.

At Kapuskasing, frost damage to the previous year's shoots and the branch tips occurred after each of the first three winters. No subsequent damage was observed.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the seedlings after five years at each site in the three regions.

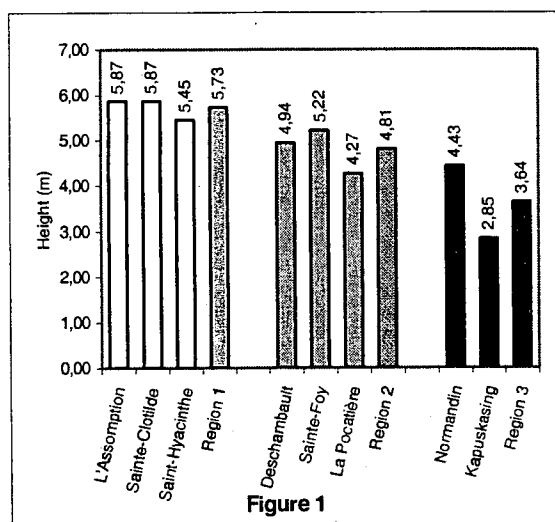


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

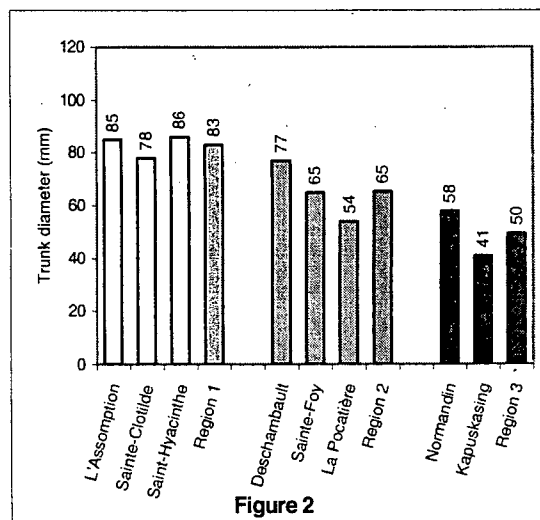


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning, other than training, was required.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

After two growing seasons, 80-95 % of the trees at Sainte-Clotilde, Saint-Hyacinthe, Deschambault, Sainte-Foy and Normandin had reached 2-3 m tall. However, the seedlings at La Pocatière, where the seeds had originally come from, grew more slowly, requiring four growing seasons to obtain a similar height. It is strongly recommended that this cultivar not be produced in region 3.

HARDINESS EVALUATION

The provenance used in this trial performed much better and was much harder than some of the other provenances

tested previously. No mortality occurred during the tests, even in zone 2a.

The cultivar can be used as far as zone 2b, with the proviso that, in this zone, the trees must be pruned every spring, at least for the first few growing seasons.

The cultivar achieved its full ornamental potential during the tests in zone 5b at Saint-Hyacinthe.

BIBLIOGRAPHIC REFERENCES

2, 7, 44, 65, 66

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Raynald Drapeau, Agr.

Michel Auger, Tech.

Table 1. Frequency of winter damage observed on *Acer saccharinum* L. (Control 1991) from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	73	27									27
Sainte-Clotilde	96	3	1								4
Saint-Hyacinthe*	100										0
REGION 2											
Deschambault	67	24	9								33
Sainte-Foy	39	57	4								61
La Pocatière	58	42									42
REGION 3											
Normandin	40	60									60
Kapuskasing	41	22	37								59

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a four-year period.

No damage of type 3, 5, 6, 7, 8, 9, 10 and 11 occurred for this species.

Table 2. Breakdown of *Acer saccharinum* L. (Control 1991) plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	29	0	0	0	0	38	0	0	0	0	-	0	0	0	0
101-200	71	14	8	8	0	62	19	0	0	0	-	20	0	0	0
201-300	0	67	0	0	8	0	67	8	0	0	-	40	17	8	0
301-400	0	19	75	8	0	0	14	67	0	0	-	40	50	9	12
401-500	0	0	17	75	0	0	0	17	58	8	-	0	33	33	0
501-600	0	0	0	9	25	0	0	8	33	50	-	0	0	50	50
601-700	0	0	0	0	67	0	0	0	9	33	-	0	0	0	38
701-800	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	19	0	0	0	0	10	0	0	0	0	85	5	0	0	0
101-200	81	19	0	0	0	90	5	0	0	0	15	81	0	0	0
201-300	0	76	42	0	0	0	85	8	0	0	0	14	58	0	0
301-400	0	5	58	42	0	0	10	92	8	0	0	0	42	75	33
401-500	0	0	0	58	58	0	0	0	92	17	0	0	0	25	67
501-600	0	0	0	0	42	0	0	0	0	83	-	-	-	-	-
601-700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
701-800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-100	9	0	0	0	0	50	0	0	0	0					
101-200	76	5	0	0	0	50	90	17	17	0					
201-300	15	85	17	8	0	0	10	75	75	62					
301-400	0	10	83	75	17	0	0	8	8	38					
401-500	0	0	0	17	75	-	-	-	-	-					
501-600	0	0	0	0	8	-	-	-	-	-					
601-700	-	-	-	-	-	-	-	-	-	-					
701-800	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Acer saccharinum* L. (Control 1991) plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	48	0	8	0	0	76	5	0	0	0	-	-	0	0	0
021-040	52	85	17	8	0	24	95	50	0	0	-	-	25	0	0
041-060	0	15	50	42	8	0	0	33	58	0	-	-	42	33	12
061-080	0	0	25	50	25	0	0	17	33	58	-	-	33	25	25
081-100	0	0	0	0	33	0	0	0	9	42	-	-	0	42	25
101-120	0	0	0	0	34	-	-	-	-	-	-	-	0	0	38
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	100	92	93	94	95	91	92	93	94	95
001-020	81	10	0	0	0	52	0	0	0	0	100	57	0	0	0
021-040	19	90	42	8	8	48	85	0	0	0	0	43	100	25	8
041-060	0	0	58	83	25	0	15	92	17	16	0	0	0	75	92
061-080	0	0	0	9	58	0	0	8	83	42	-	-	-	-	-
081-100	0	0	0	0	9	0	0	0	0	42	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	95	30	0	0	0	100	60	25	0	0					
021-040	5	70	100	33	0	0	40	75	83	37					
041-060	0	0	0	67	42	0	0	0	17	63					
061-080	0	0	0	0	58	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1993.

ACER SACCHARINUM

L. (CONTROL 1992)

The sections Botanical Description, Origin and Distribution, Use and Requirements can be found in the first series of fact sheets (02-9227) and in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume I (95-0070).

DISEASES AND INSECTS

Anthracnose (*Gloeosporium* sp.), eutypella canker (*Eutypella parasitica*) and septoria spot (*Septoria* sp.) are fungal diseases that may strike maples during periods favourable to the development of disease or after breaks or mechanical injury. In general, maples are susceptible to scale insects, including the oystershell scale (*Lepidosaphes ulmi*), cottony maple scale and lecanium scale.

Foliage damage may also be caused by leafhoppers. Japanese Beetles (*Popillia japonica*) attack the aerial portion of the plant. This insect occurs in southwestern Quebec and the Richelieu Valley.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, La Pocatière (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds were harvested in early June 1990 from a 70-year-old parent plant measuring 20 m high, with a 750-cm-diameter trunk. On mid-June, the seeds were received and sown in a cold frame in a Promix®-sand mixture (1:2; v:v), shaded by a cloth (63 %). Planting depth was 10 mm. They were watered for one hour a day during the growing season, except on rainy days. Emergence occurred over roughly ten days. Average height growth during the first season was 15-20 cm. The

seedlings were dug up in mid-October and heeled in for the winter. On May 24, 1991, 400 seedlings were transplanted to the nursery, where they were grown until fall. On October, they were again dug up, puddled and heeled in until the spring of 1992. The winter survival rate was 100 %. On April 17, they were wrapped and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Seedlings 70 cm high and 8 mm in diameter were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Branch tips and old wood damage occurred in all sites.

Region 1

At L'Assomption, a plant died the fourth winter. 95 % and 100 % of the seedlings had frost damage to the branch tips the first two winters, one tree was affected on the old wood the first winter and an other tree suffered from sunscald, trunk spitting the third and fifth winters. Mechanical damages affected 27 % of the plants the last winter.

At Sainte-Clotilde, frost damage to the branch tips occurred in 53 % of seedlings the first winter and 31 % of the plants were affected to the previous year's shoots and 10 % on the old wood. No other damage occurred.

At Saint-Hyacinthe, the previous year's shoots was affected on 29 % of the plants the first winter and damage occurred on the branch tips on 24 % and 67 % of the plants the two first winters. No other damage occurred.

Region 2

At Deschambault, frost damage to the branch tips occurred on 33 %, 9 % and 8 % of the plants the first three winters. The two first winters, seedlings suffered frost damage to the previous year's shoots. A tree showed sunscald, trunk spitting the fourth winter.

At Sainte-Foy, frost damage to the branch tips occurred each winters on 95 %, 75 %, 25 %, 25 % and 25 % of the plants. Damage to the old wood was observed after each of the first three winters on 5 %, 25 % and 75 % of the trees. A plant was affected by mechanical damage the last winter.

At La Pocatière, 95 %, 90 % and 42 % of trees suffered frost damage to the branch tips the first three winters. Damage to the previous year's shoots occurred on 5 % and 9 % the two first winters. No other damage was observed.

Region 3

At Normandin, a plant died the third winter. All seedlings suffered frost damage to the previous year's shoots the first winter and to the snow level the second winter. No subsequent damage was observed.

At Kapuskasing, a plant died the third winter. Frost damage to the previous year's shoots occurred after each winters to 81 %, 95 %, 58 %, 82 % and 27 % of the plants. Branch tips damage were observed on 19 %, 17 %, 9 % and 45 % the first and three last winters. A tree was affected to the ground level the second winter.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the seedlings after five years at each site in the three regions.

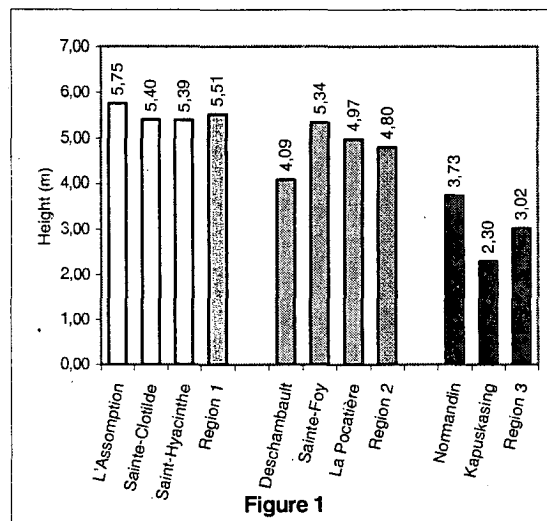


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

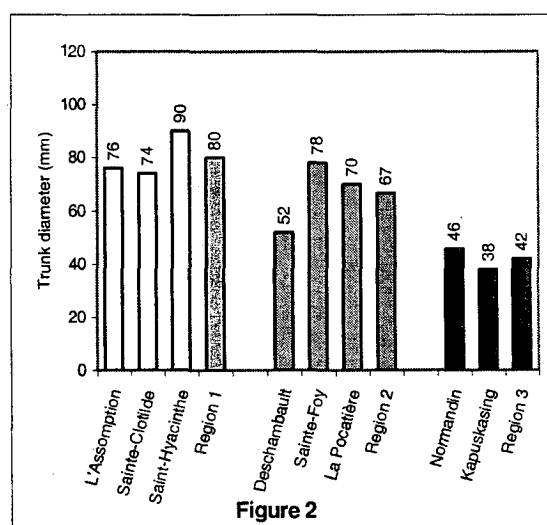


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning, other than training, was required.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year).

Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

After three growing seasons, 80 % of the trees at Sainte-Clotilde, Saint-Hyacinthe, L' Assomption and Sainte-Foy had reached 2-3 m tall and a trunk diameter between 41 to 80 mm.

However, the seedlings at La Pocatière, where the seeds had originally come from, grew more slowly, requiring four growing seasons to obtain a similar height. An supplementary growing season was required for the Deschambault plants. It is strongly recommended that this cultivar not be produced in region 3 because 45 % of the Kapuskasing plants did not foreign this growth at the end of the trial.

HARDINESS EVALUATION

The provenance used in this trial performed much better and was much hardier than some of the other provenances tested previously. The species can survive in zone 2a and can be used as far as zone 2b, with the proviso that, in this zone, the trees must be pruned every spring, at least for the first few growing seasons.

The cultivar achieved its full ornamental potential during the tests in zone 5b at Saint-Hyacinthe.

Damages occurred the first two winters and did not affect the growth of the trees. A paper, submitted in the Canadian Journal of Plant Science (2001) explained more specifically the growth model of the species in relation with the mother plants age.

BIBLIOGRAPHIC REFERENCES

3, 7, 62, 63, 64, 65, 66

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Acer saccharinum* L. (Control 1992) from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	73	27										27
Sainte-Clotilde	96	3		1								4
Saint-Hyacinthe*	100											0
REGION 2												
Deschambault	67	24		9								33
Sainte-Foy	39	57		4								61
La Pocatière	58	42										42
REGION 3												
Normandin	40	60										60
Kapuskasing	41	22		37								59

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

*Damage was evaluated over a four-year period.

No damage of type 3, 5, 6, 9 and 11 occurred for this species.

Table 2. Breakdown of *Acer saccharinum* L. (Control 1992) plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	29	0	0	0	0	38	0	0	0	0	-	0	0	0	0
101-200	71	14	8	8	0	62	19	0	0	0	-	20	0	0	0
201-300	0	67	0	0	8	0	67	8	0	0	-	40	17	8	0
301-400	0	19	75	8	0	0	14	67	0	0	-	40	50	9	12
401-500	0	0	17	75	0	0	0	17	58	8	-	0	33	33	0
501-600	0	0	0	9	25	0	0	8	33	50	-	0	0	50	50
601-700	0	0	0	0	67	0	0	0	9	33	-	0	0	0	38
701-800	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-

REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	19	0	0	0	0	10	0	0	0	0	85	5	0	0	0
101-200	81	19	0	0	0	90	5	0	0	0	15	81	0	0	0
201-300	0	76	42	0	0	0	85	8	0	0	0	14	58	0	0
301-400	0	5	58	42	0	0	10	92	8	0	0	0	42	75	33
401-500	0	0	0	58	58	0	0	0	92	17	0	0	0	25	67
501-600	0	0	0	0	42	0	0	0	0	83	-	-	-	-	-
601-700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
701-800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

REGION 3										
Height (cm)	Normandin					Kapuskasing				
	91	92	93	94	95	91	92	93	94	95
001-100	9	0	0	0	0	50	0	0	0	0
101-200	76	5	0	0	0	50	90	17	17	0
201-300	15	85	17	8	0	0	10	75	75	62
301-400	0	10	83	75	17	0	0	8	8	38
401-500	0	0	0	17	75	-	-	-	-	-
501-600	0	0	0	0	8	-	-	-	-	-
601-700	-	-	-	-	-	-	-	-	-	-
701-800	-	-	-	-	-	-	-	-	-	-

*Dats were collected since 1992.

Table 3. Breakdown of *Acer saccharinum* L. (Control 1992) plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	48	0	8	0	0	76	5	0	0	0	-	-	0	0	0
021-040	52	85	17	8	0	24	95	50	0	0	-	-	25	0	0
041-060	0	15	50	42	8	0	0	33	58	0	-	-	42	33	12
061-080	0	0	25	50	25	0	0	17	33	58	-	-	33	25	25
081-100	0	0	0	0	33	0	0	0	9	42	-	-	0	42	25
101-120	0	0	0	0	34	-	-	-	-	-	-	-	0	0	38
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	81	10	0	0	0	52	0	0	0	0	100	57	0	0	0
021-040	19	90	42	8	8	48	85	0	0	0	0	43	100	25	8
041-060	0	0	58	83	25	0	15	92	17	16	0	0	0	75	92
061-080	0	0	0	9	58	0	0	8	83	42	-	-	-	-	-
081-100	0	0	0	0	9	0	0	0	0	42	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	95	30	0	0	0	100	60	25	0	0					
021-040	5	70	100	33	0	0	40	75	83	37					
041-060	0	0	0	67	42	0	0	0	17	63					
061-080	0	0	0	0	58	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1993.

ACER SPICATUM LAM.

Family:	Aceraceae
English name:	Mountain Maple
French name:	Érable à épis, plaine bâtarde
Category:	Deciduous plant
Subdivision:	Medium-sized tree

BOTANICAL DESCRIPTION

This small tree or shrub can grow to 7 to 8 m tall and 4 m wide. It has a short, often twisted, trunk, irregularly divided into a few ascending, slender, rather straight branches, which form an open, rounded but asymmetrical crown.

The thin bark is dull reddish brown to greyish brown in colour and smooth, eventually becoming slightly furrowed.

The slender branchlets are yellowish green to reddish brown in colour, covered with short grey hairs giving them a somewhat velvety look. The buds are straight, stalked and two to three times as long as wide.

The foliage is pale green in summer, changing to red, yellow or brown in fall. The leaves are simple and three-lobed. The blade is a little longer than wide, with a yellowish-green upper surface and silky white hairs coating the underside. The slender, reddish stem is usually longer than the blade. The leaf margin is coarsely and irregularly serrate, with single teeth that typically curve outwards.

The flowers, borne in erect spikes, appear after leaf-out.

The inflorescences contain both male and female flowers, which are pale yellowish-green in colour. They measure 7 to 8 mm across and are borne on slender, often branched, pedicels.

The fruits (samaras) are usually reddish in summer, turning yellow or pinkish brown in the fall. Each samara is about 2 cm long, with wings of equal length that form a right angle with the peduncle. The seedcase is indented on one side.

The root system is shallow.

ORIGIN AND DISTRIBUTION

This indigenous shrub ranges from Labrador to Saskatchewan and south to northern Georgia. It prefers cool, shady, moist situations.

USE

Naturalization: This species can be used for naturalization purposes.

Ornamental: Its foliage and fruits make it decorative.

REQUIREMENTS

This partial-shade species grows best in a sandy-textured, acidic soil with plenty of moisture and constantly cool conditions. Though very hardy, this tree which is native to Quebec and not very exacting, is sensitive to urban pollution. It must be transplanted balled and burlapped.

DISEASES AND INSECTS

This species has few disease and insect problems. However, at Deschambault, the tree trunks were black and covered with oozing pustules and the leaves had necrotic zones. The seedlings died during the final growing season.

PROPAGATION

Seeds: The seeds exhibit embryonic dormancy and have low viability when the humidity level falls below 15%. Therefore, they should not be allowed to dry out too much. The seeds must be stratified for at least 90 days in wet peat at 5 °C. Alternatively they can be planted in beds in the fall.

Layering: This species can be layered easily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Route 268, Miguasha Est, Gaspé (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: Seeds were collected on August 13, 1987 from several mature specimens over a distance of about 250 m along the highway. They were kept at 4 °C and then sowed in outdoor cold frames on June 28, 1988. The seedlings were transplanted on June 15, 1989; they were 5 cm tall and very homogeneous. In August, 240 seedlings were potted in Fertil Pot® containers, and then planted in beds for the winter protected by cold frames covered with plywood. The winter survival rate was 100 %. They were grown in these cold frames until being shipped in May 1991.

Inclusion in testing network: Seedlings 45 cm tall were planted at eight test sites distributed across Quebec and northeastern Ontario. Their winter survival and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the winter damage observed over a five-year period. Details of the main types of damage that occurred each winter at the different sites are given below.

Region 1

At L'Assomption, 12 % and 42 % of the seedlings died in the first and fourth winters respectively. In addition, 88 % and 22 % of the seedlings suffered frost damage on the stem tips during the first two winters.

At Sainte-Clotilde, two seedlings died the first winter.

At Saint-Hyacinthe, one seedling died during the third winter.

Region 2

In Sainte-Foy, most of the damage occurred in the first winter: frost damage on branch tips was observed in the first and fourth winters on 63 % and 83 % of the seedlings. Damage to the year-old shoot and old wood were recorded in 16 % and 5 % of the seedlings respectively.

At Deschambault, all of the seedlings died over the first two winters. In the fourth winter, the surviving plants showed evidence of frost injury right down to the ground level.

At La Pocatière, one seedling exhibited breakage caused by the climatic conditions during the fourth winter.

Region 3

At Normandin, one seedling died the first winter. In the third and fourth winters, 17 % of the seedlings were impacted by breakage. Frost damage on the stem tips was observed following the first three winters on 20 % to 25 % of the seedlings. In the second winter, 53 % of the seedlings suffered frost injury on the previous year's shoot.

At Kapuskasing, 67 % and 57 % of the seedlings died during the first two winters. Frost damage to the stem tips was observed in 24 % and 43 % of seedlings the first two winters. One of the two surviving seedlings suffered frost on the previous year's shoot in the third winter and it was affected by breakage owing to climatic conditions during the fifth winter.

Height and trunk diameter growth

Figures 1 and 2 show the average height and diameter of the trees after five years of testing at each site in the different regions.

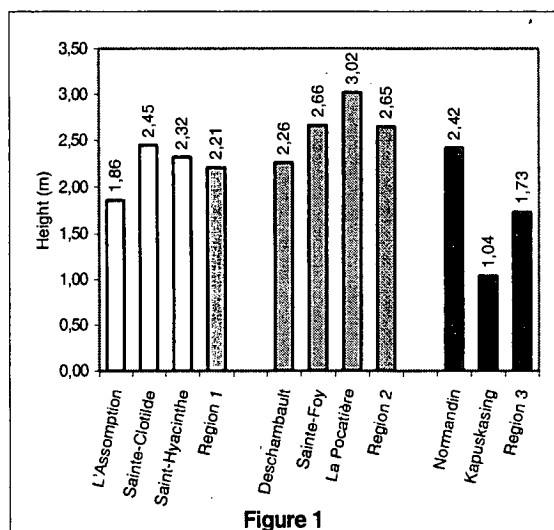


Figure 1

Figure 1. Average height of the trees at test completion for the eight sites and the three regions

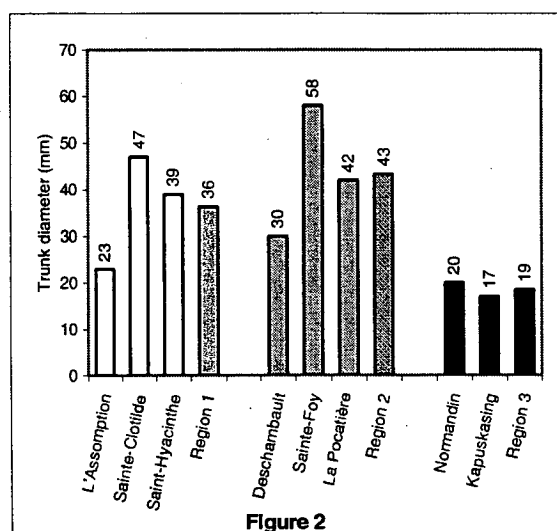


Figure 2

Figure 2. Average trunk diameter at test completion for the eight sites and the three regions

Effect of pruning

Only pruning to train the seedlings was necessary. It was slightly heavier at the colder sites some years.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year according to final height and trunk diameter classes.

Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and trunk diameter.

The test results showed that after three years 90 % to 100 % of the trees were taller than 1 m, except those at L'Assomption and Kapuskasing.

This indigenous plant prefers slightly wet and acidic soils. At Kapuskasing, the soil is clayey and alkaline and the trees died off rapidly.

This species can be grown in regions 1 and 2.

HARDINESS EVALUATION

In the references consulted, this indigenous plant is classified as having zone 2 hardiness. The test results show that this provenance is poorly adapted to growing in clayey, calcareous soil like that at Kapuskasing. However, it survived in zone 2b and can be used there. Full ornamental expression was achieved at the La Pocatière, Saint-Hyacinthe and Sainte-Clotilde sites.

Since the species' natural range extends from Labrador to northern Georgia, the hardiness of the parent plants is probably closely linked to the particular environment from which they came.

BIBLIOGRAPHIC REFERENCES

1, 2, 7, 32, 33, 34, 39, 67, 75

WRITTEN BY

Claude Richer, Agr.

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Raynald Drapeau, Agr.

Table 1. Frequency of winter damage observed on *Acer spicatum* Lam. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	0						100				100
Sainte-Clotilde	98						2				2
Saint-Hyacinthe	98						2				2
REGION 2											
Deschambault	56	3	1			15	25				44
Sainte-Foy	67	29	3	1							33
La Pocatière	98								2		2
REGION 3											
Normandin	69	13	10				1		7		31
Kapuskasing	42	13	10				25		10		58

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 6, 9 and 11 occurred for this species.

Table 2. Breakdown of *Acer spicatum* Lam. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	100	93	50	25	20	100	47	10	0	0	-	0	0	0	0
101-200	0	7	50	67	40	0	53	90	20	10	-	100	90	63	30
201-300	0	0	0	8	40	0	0	0	80	81	-	0	10	37	70
301-400	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-
401-500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	100	14	0	0	0	100	11	0	0	0	96	0	0	0	8
101-200	0	86	82	70	44	0	89	100	0	0	4	100	11	0	0
201-300	0	0	18	30	56	0	0	0	100	100	0	0	89	67	17
301-400	-	-	-	-	-	0	0	0	0	0	0	0	0	33	67
401-500	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-100	100	36	0	10	0	100	86	50	50	50					
101-200	0	64	86	90	25	0	14	50	50	50					
201-300	0	0	14	0	75	-	-	-	-	-					
301-400	-	-	-	-	-	-	-	-	-	-					
401-500	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Acer spicatum* Lam. plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	79	33	17	14	95	11	0	0	0	-	-	0	0	0
011-020	0	21	50	50	29	5	79	0	0	0	-	-	0	0	0
021-030	0	0	17	25	57	0	10	42	17	8	-	-	75	45	18
031-040	0	0	0	8	0	0	0	58	58	8	-	-	25	27	45
041-050	-	-	-	-	-	0	0	0	17	50	-	-	0	28	18
051-060	-	-	-	-	-	0	0	0	8	25	-	-	0	0	19
061-070	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	14	0	0	0	84	0	0	0	0	100	0	0	0	8
011-020	0	86	33	8	0	16	31	0	0	0	0	100	0	0	0
021-030	0	0	67	75	56	0	69	0	0	0	0	0	75	0	0
031-040	0	0	0	17	44	0	0	58	0	0	0	0	25	83	8
041-050	-	-	-	-	-	0	0	25	25	8	0	0	0	17	75
051-060	-	-	-	-	-	0	0	17	67	67	0	0	0	0	9
061-070	-	-	-	-	-	0	0	0	8	17	-	-	-	-	-
071-080	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	95	32	0	17	0	85	43	50	0	0					
011-020	5	63	83	66	58	15	57	50	100	100					
021-030	0	5	17	17	42	-	-	-	-	-					
031-040	-	-	-	-	-	-	-	-	-	-					
041-050	-	-	-	-	-	-	-	-	-	-					
051-060	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1993.

AESCULUS HIPPOCASTANUM L.

Family:	Hippocastanaceae
English name:	Common Horse Chestnut
French name:	Marronnier d'Inde, châtaignier des chevaux, bois de Spa
Synonym:	<i>Aesculus ohioensis</i>
Category:	Deciduous plant
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This horsechestnut has an oval to rounded outline and can reach a height of 20 m and a spread of 14 m.

The trunk is covered with greyish bark, which is initially smooth but becomes scaly with age. Young shoots are reddish in colour. The branches bear breakable, more or less flexible branchlets. The highly characteristic buds, which are sticky in winter, measure 1 to 2 cm across.

The leaves are opposite and palmately compound with five to seven leaflets, which are sessile, obovate and serrate. The leaves are 10 to 25 cm long, coarse textured, dark green above and pale green below. They turn a golden yellow in the fall. The dense foliage casts heavy shade.

The flowers are white with a bright red centre and form erect clusters 15 to 20 cm long. Abundant and very showy, they appear near the end of May or in early June.

The many globose fruits are decorative but inedible. The seeds, resembling chestnuts, are contained in brown, spiny capsules measuring 5 cm across. The seed is smooth and dark reddish brown with a lighter brown halo at the base.

The downward-growing roots are branched.

ORIGIN AND DISTRIBUTION

The common horsechestnut is indigenous to Greece and Albania. It was introduced into Western Europe in 1576 and then into the British Isles in the early 17th century.

USE

Ornamental: This tree is prized for its shape, foliage and flowering. Its fruits are toxic unfortunately. It can be planted as a specimen tree or in rows, but is used primarily for large open spaces.

REQUIREMENTS

This species prefers full sun, but conditions should not be too hot. It grows best in rich, fertile soil with a neutral pH and can tolerate slightly alkaline soil. The common horsechestnut does not stand up well to drought, which can cause yellowing of its foliage in summer. It is not easy to transplant and transplanting should be done in the spring. The species tolerates de-icing chemicals and urban pollution.

DISEASES AND INSECTS

This species is slightly susceptible to white rot, leaf spot, rust diseases and nectria canker. It is not seriously affected by insect pests.

PROPAGATION

Seeds: Seeds can be sowed in the fall. Alternatively they can be stratified in wet sand at 5 °C, but their germination capacity decreases after six months.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, La Pocatière (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were collected on October 10, 1989 from parent plants that were about 45 years old and 9 m tall. They were received on October 19 and sowed in cold frames on October 23. The seeds were planted 4 cm deep in a Promix® and sand (2:3; v:v) medium and covered with peat. The start of germination

was recorded in May 1990 at less than 50 %. On May 24, 140 seedlings were transplanted to the nursery, spaced 30 cm apart in rows. On October 23, the seedlings were dug up, puddled and heeled in. On April 18, 1991, they were packed in plastic bags and placed in the cold store at 5 °C until they were shipped.

Inclusion in testing network: Seedlings 5 to 7 cm tall were planted at eight test sites distributed across Quebec and northeastern Ontario. Their winter survival and their potential were assessed from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed over a five-year period. Details are provided below of the main types of damage that occurred each winter at the different sites.

Region 1

At L'Assomption, 28 % and 9 % of the seedlings suffered frost damage on the stem tips in the second and fourth winters.

At Sainte-Clotilde, 13 % and 23 % of the seedlings died during the first two winters. No damage occurred subsequently.

At Saint-Hyacinthe, 13 % and 17 % of the seedlings died in the first and third winters. Frost damage was observed on the year-old shoot in 7 % of the seedlings after the second winter. No damage occurred subsequently.

Region 2

At Sainte-Foy, 6 % of the seedlings died the first winter. Frost damage on the stem tips was recorded in 7 % of seedlings in the first, second and fourth winters. Damage was observed on the year-old shoot during the fourth winter in only one seedling.

At Deschambault, one seedling died the first winter. Frost injury on the previous year's shoot was recorded in 36 % and 9 % of the seedlings during the third and fourth winters. The stem tips were damaged during the last two winters in 18 % and 27 % of the seedlings.

At La Pocatière, two seedlings died the first winter. Frost damage on the stem tips was recorded in 17 % of the seedlings during the second, third and fourth winters. Frost damage on the previous year's shoot was observed in 17 % and 9 % of the seedlings during the second and third winters.

Region 3

At Normandin, frost damage on the stem tips occurred in all of the seedlings during the second winter.

At Kapuskasing, one seedling died during the second and fourth winters. In the third winter, 36 % of the trees froze to the ground level. Frost damage on the stem tips was recorded in 34 % of the seedlings, whereas damage on the year-old shoot was observed in the second, third and fourth winters in about 10 % of the seedlings.

Height and trunk diameter growth

Figures 1 and 2 show the average height and trunk diameter of the trees after five years of testing for at each sites in the different regions.

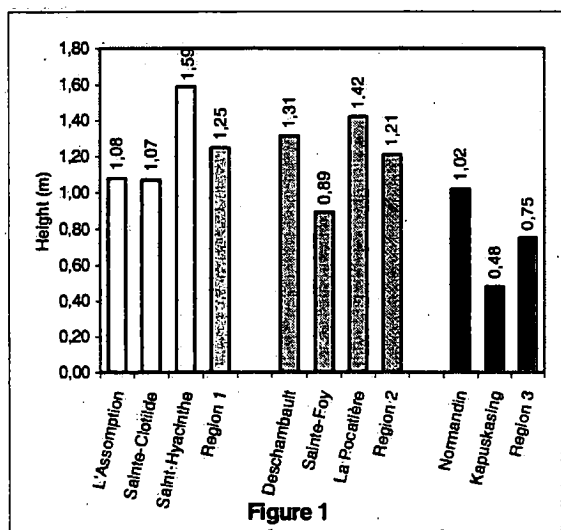


Figure 1. Average height at test completion for the eight sites and the three regions

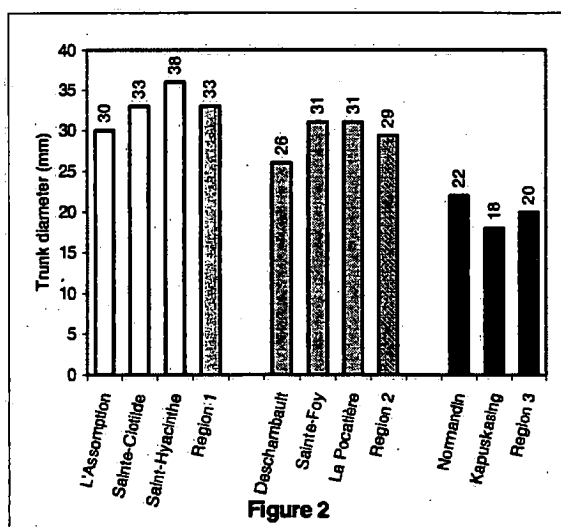


Figure 2. Average trunk diameter at test completion for the eight sites and the three regions

Effect of pruning

The only type of pruning done was aimed at training the tree.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year according to final height and width classes. Nursery operators will find these

tables useful for estimating annual production and the number of years it should take to obtain a given height and diameter.

This species can be grown in regions 1 and 2 as well as at Normandin, but its growth is very slow. It took six growing seasons to obtain a majority of trees (75 % or over) that were more than a metre tall at the L'Assomption, Saint-Hyacinthe, Sainte-Foy and La Pocatière sites. At the other sites, except for Kapuskasing, the corresponding percentage varied between 40 % and 60 % after five years. Selecting a suitable seed provenance is very important.

HARDINESS EVALUATION

According to the literature consulted, this species' hardiness rating falls between 3b and 5. The test results show that it can survive at least as far north as zone 2a. However, the seedlings' slow growth precludes a determination of the zone where the tree can develop appropriately and flower. Mature trees have been inventoried in the Montreal, Quebec City and Lower St Lawrence areas. The species' hardiness varies widely with the seed provenance. The seeds should be collected from trees that grow in the most northerly regions possible. It should be kept in mind that the seeds used in the present test came from a tree at La Pocatière.

BIBLIOGRAPHIC REFERENCES

2, 7, 9, 18, 31, 35, 39, 41, 76, 77

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Raynald Drapeau, Agr.

Michel Auger, Tech.

Table 1. Frequency of winter damage observed on *Aesculus hippocastanum* L. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE*									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	92	8									8
Sainte-Clotilde	93						7				7
Saint-Hyacinthe*	93		1				6				7
REGION 2											
Deschambault	78	9	9				2		2		22
Sainte-Foy	93	5	2								7
La Pocatière	81	11	5				3				19
REGION 3											
Normandin	80	20									20
Kapuskasing	48	34	7				8	3			52

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a four-year period.

No damage of type 3, 5, 6, 9 and 11 occurred for this species.

Table 2. Breakdown of *Aesculus hippocastanum* L. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-025	14	43	0	0	0	33	38	10	0	0	-	14	8	0	0
026-050	86	57	64	18	18	67	54	60	20	0	-	43	17	0	0
051-075	0	0	36	27	0	0	8	30	30	20	-	21	58	20	0
076-100	0	0	0	45	9	0	0	0	50	20	-	0	17	30	0
101-125	0	0	0	10	45	0	0	0	0	30	-	0	0	30	20
126-150	0	0	0	0	28	0	0	0	0	30	-	15	0	20	20
151-175	-	-	-	-	-	-	-	-	-	-	-	7	0	0	30
176-200	-	-	-	-	-	-	-	-	-	-	-	0	0	0	10
201-225	-	-	-	-	-	-	-	-	-	-	-	0	0	0	20
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-025	62	25	9	0	0	67	21	0	0	0	57	25	10	10	10
026-050	38	75	36	36	18	33	71	25	0	8	43	58	27	0	0
051-075	0	0	45	18	18	0	8	67	17	0	0	17	36	0	0
076-100	0	0	10	46	9	0	0	8	25	17	0	0	27	27	18
101-125	0	0	0	0	45	0	0	0	25	25	0	0	0	27	0
126-150	0	0	0	0	10	0	0	0	33	25	0	0	0	36	18
151-175	-	-	-	-	-	0	0	0	0	0	0	0	0	0	27
176-200	-	-	-	-	-	0	0	0	0	8	0	0	0	0	27
201-225	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-025	57	8	0	8	8	40	13	9	9	10					
026-050	43	84	54	17	0	60	80	55	64	50					
051-075	0	8	46	50	8	0	7	36	27	30					
076-100	0	0	0	25	42	0	0	0	0	10					
101-125	0	0	0	0	17	-	-	-	-	-					
126-150	0	0	0	0	17	-	-	-	-	-					
151-175	-	-	-	-	-	-	-	-	-	-					
176-200	0	0	0	0	8	-	-	-	-	-					
201-225	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Aesculus hippocastanum* L. plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	43	18	9	9	53	31	0	0	0	-	-	0	0	0
011-020	0	57	45	18	9	47	69	60	30	0	-	-	42	0	0
021-030	0	0	37	36	36	0	0	30	40	40	-	-	50	60	30
031-040	0	0	0	37	18	0	0	10	30	40	-	-	8	20	50
041-050	0	0	0	0	28	0	0	0	0	20	-	-	0	20	10
051-060	0	0	0	8	0	-	-	-	-	-	-	-	0	0	10
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	33	27	27	9	80	14	0	0	0	85	25	9	9	9
011-020	0	67	36	9	27	20	78	58	25	8	15	75	55	27	0
021-030	0	0	27	46	27	0	8	42	25	42	0	0	36	45	36
031-040	0	0	10	18	27	0	0	0	25	33	0	0	0	9	37
041-050	0	0	0	0	10	0	0	0	25	17	0	0	0	0	18
051-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	71	31	0	8	8	73	27	0	45	10					
011-020	29	69	82	42	33	27	73	91	27	60					
021-030	0	0	18	42	42	0	0	9	28	20					
031-040	0	0	0	8	17	0	0	0	0	10					
041-050	-	-	-	-	-	-	-	-	-	-					
051-060	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1993.

AMORPHA FRUTICOSA L.

Family:	Fabaceae
English name:	Indigobush Amorpha or False Indigo
French name:	Faux indigo or amorpha
Synonym:	<i>Amorpha pubescens</i>
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This bushy shrub, erect and irregular in habit, may grow to 3 m tall and 2 m wide.

The upright branches have slightly downward curving tips, which give it the shape of an inverse pyramid.

The greyish bark turns brown with age.

The imbricate buds, often superimposed and glabrous, are greyish brown in colour.

The deciduous leaves are compound or twice compound, with 11-25 leaflets. The leaflets, oval to elliptic in shape, are slightly pubescent and 4-5 cm long. The fine, dense foliage gives the plant a light, airy look. The leaves are light green in summer and turn yellow in fall.

The flowers, borne on erect spikes, are bluish purple with yellow anthers. They bloom from mid-June to late August. Each flower is 1-2 cm in size and the panicles are 15-20 cm long.

The fruits, 7-9 cm long pods, remain on the shrub in winter.

The shrub is shallow-rooted, with fibrous, sometimes suckering, roots that anchor it well.

ORIGIN AND DISTRIBUTION

The shrub is native to the southern and southeastern United States, where it occurs naturally on sunny riverbanks and in poor soil. It tolerates drought well.

USE

Ornamental: This plant, very useful in places where it is difficult to grow other plants, can be used as a specimen plant or in mass plantings with other shrubs. Its attractive flowers and ease of cultivation makes it a very valuable ornamental shrub.

Naturalization: Since it adapts readily to difficult locations, it is well suited to naturalization.

REQUIREMENTS

Even though the plant can be grown in a lightly shaded location, it does best in full sun. Not very demanding about soil, it can thrive in poor, slightly acid or calcareous soils. Although the species is drought tolerant, it grows better in slightly moist soils. It needs to be pruned back hard in spring to encourage the new flowering shoots to appear. Its root system is well adapted to transplanting.

DISEASES AND INSECTS

There is no specific information on this species in the Réseau d'avertissements phytosanitaires.

PROPAGATION

Seeds: The most common method of propagating the species is from seed, to ensure species characteristics are transmitted to individuals. The fruits are harvested not too late in fall to ensure they are soft enough. The seeds are sown in a light substrate, in a shaded location.

Cuttings: This technique usually involves the use of heel cuttings (with a heel of old wood at the base). The cuttings can be heeled in for the winter and kept in a storeroom, shed, or cold store. They are then allowed to root in spring.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum, Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were harvested on October 4, 1988. The seeds were extracted by drying the pods and were then stored in a dry place. On May 10, 1989, the seeds were immersed in hot water (90 °C), and then kept in water at 20 °C for 24 hours. They were then sown 10 mm deep in a Promix[®]-sand mixture (1:3; v:v) and placed in a lathhouse (63 % shade). The seeds sprouted over a period of two weeks; the mean height growth the first year was 5 cm. The seedlings were overwintered in a propagation bed without any special protection. In fall 1990, they were dug up and heeled in for the winter. On May 23, 1991, they were transplanted to the nursery. On October 15, they were dug up, puddled and again heeled in for the winter. The survival rate was 100 %. In mid-April 1992, they were wrapped and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Young seedlings 15-20 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, all the plants were damaged during the first four winters. The first winter, one seedling died and the rest suffered damage to the old wood; the second winter, half of the seedlings suffered frost damage down to the snow cover and the other half, down to the ground level. The third and fourth winters, all the shrubs suffered damage to the one-year-old shoots and the branch tips.

At Sainte-Clotilde, two shrubs died the first winter and the others had frost damage to the old wood. The following winter, all plants suffered frost damage down to the snow cover. During the remaining winters, all shrubs suffered damage to the previous year's shoots.

At Saint-Hyacinthe, all shrubs froze down to the snow cover the first winter. The second winter, 31 % of plants had similar damage, while the others suffered frost damage to the branch tips. The third and fourth winters, the branch tips were affected in all shrubs. In addition, one shrub died the fourth winter. The last winter, rodent damage was observed in 42 % of shrubs, while frost damage to the old wood was seen in 17 % and frost damage to the previous year's shoots was observed in 33 %.

Region 2

Two seedlings died at Sainte-Foy during the first two winters. All plants had frost damage down to the snow cover in the first, fourth and fifth winters. Frost damage down to the ground occurred in 85 % of plants the second winter, with the remaining plants showing frost damage down to the snow cover. The following year, 83 % of the shrubs had frost damage to the previous year's shoots, and 17 % down to the ground level.

At Deschambault, 62 % and 95 % of seedlings froze down to the ground level in the first two winters. Frost damage to the previous year's shoots occurred in the other seedlings the first winter. The second winter, one plant died and, in subsequent winters, all shrubs had frost damage to the previous year's shoots.

At La Pocatière, the first two winters, all seedlings suffered frost damage either down to the snow cover (67 %) or to the ground level (33 %). Subsequently, frost damage to the branch tips was observed every winter in close to half of the plants and damage to the aerial portion above the snow cover occurred in 33 %, 50 % and 17 % of plants. Frost damage to the previous year's shoots occurred in one

shrub the third winter and in 42 % of shrubs the last winter.

Region 3

At Normandin, a single seedling survived the first winter, but died the subsequent one.

At Kapuskasing, two seedlings died the first two winters. All the other plants suffered frost damage down to the ground level each winter. .

Height and width growth

Figures 1 and 2 show the average height and width of the plants after five years of testing at each site in the three regions.

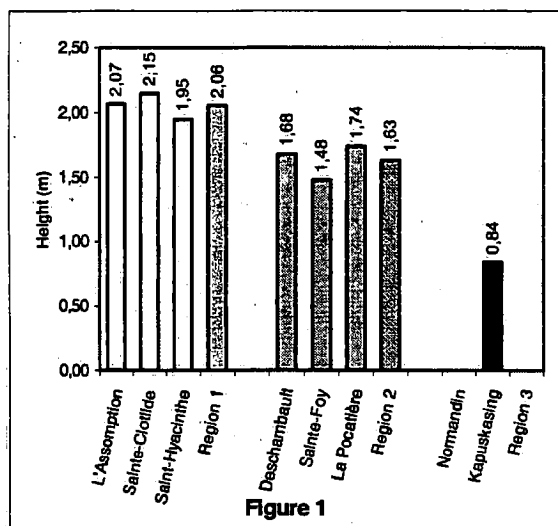


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions.

Final height increased yearly at all region 1 sites, while growth was not observed the last year at Sainte-Foy and Kapuskasing.

Width exceeded height by the second year at all sites except Normandin.

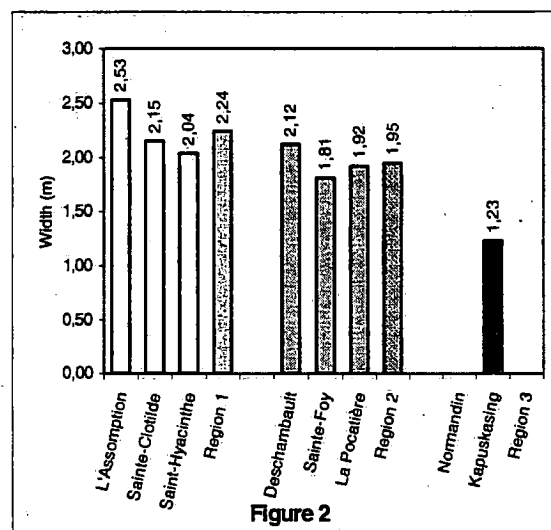


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions.

Effect of pruning

The plants had to be pruned back substantially at all sites, resulting in the removal of 50-90 % of biomass. Shrubs at Sainte-Clotilde were only pruned once, in the third year, which reduced their height by 57 %.

Flowering

At L'Assomption, flowering was sparse the first year after planting, and lasted 7-9 days. At all other region 1 sites, flowering began around June 24, except a few years when flowers appeared during the first week of June and flowering lasted around 16 days. In region 2, the duration of flowering was 12-26 days, and increased every year. No flowering occurred in region 3.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

The aerial portions of the plant were strongly affected by climatic conditions and the resulting damage required significant pruning every spring at almost all the sites.

Production is possible only if branches can be protected from frost damage in fall and winter.

HARDINESS EVALUATION

According to the literature, this species is hardy to between zone 2 and zone 4. Although most of the shrubs at Kapuskasing survived, the results of the trial indicate that survival is not a sure thing in zone 2, since all the plants died the first two winters in Normandin.

The species had to be cut back severely every spring in zones 4 and 5, but grew vigorously afterward, flowering from the current year's wood. Therefore, it can be used as far as zone 4.

The species did not achieve its full ornamental potential in all the zones tested.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 9, 21, 28, 31, 33, 35, 39

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Table 1. Frequency of winter damage observed on *Amorpha fruticosa* L. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		1	2	3	4	5	6	7	8	10	
REGION 1											
L'Assomption	20	20		20	19	12	8	1			80
Sainte-Clotilde	0			60	17	20		3			100
Saint-Hyacinthe	2	52		7	3	26		2		8	98
REGION 2											
Deschambault	0			66			31	3			100
Sainte-Foy	1			16		58	21	4			99
La Pocatière	0	28		10		47	15				100
REGION 3											
Normandin	0						5	95			100
Kapuskasing	0						95	5			100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 10 occurred for this species.

Table 2. Breakdown of *Amorpha fruticosa* L. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	15	0	0	0	0	5	0	0	0	0	5	5	0	0	0
051-100	70	10	8	8	0	66	5	0	0	0	45	20	8	0	0
101-150	15	90	50	0	8	29	69	25	0	0	50	75	46	23	0
151-200	0	0	42	84	17	0	26	75	100	34	0	0	46	77	75
201-250	0	0	0	8	75	0	0	0	0	66	0	0	0	0	25
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	14	5	8	0	0	24	10	8	0	17	19	5	0	0	0
051-100	86	38	17	45	0	76	30	9	8	0	81	38	0	0	0
101-150	0	57	75	55	18	0	60	83	17	8	0	57	100	92	8
151-200	0	0	0	0	82	0	0	0	75	75	0	0	0	8	92
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin*					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	0	100	-	-	-	29	5	9	0	9					
051-100	100	0	-	-	-	71	95	73	91	18					
101-150	-	-	-	-	-	0	0	18	9	73					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

*At Normandin, all plants were died after the second winter.

Table 3. Breakdown of *Amorpha fruticosa* L. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	-	-	-	-	-	10	0	0	0	0	-	-	-	-	-
051-100	35	10	8	8	0	57	0	0	0	0	45	25	0	0	0
101-150	65	74	0	0	8	33	63	0	0	0	55	25	15	15	0
151-200	0	16	92	17	0	0	37	16	25	33	0	50	54	31	50
201-250	0	0	0	75	33	0	0	75	75	67	0	0	31	54	50
251-300	0	0	0	0	59	0	0	9	0	0	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	10	5	0	0	0	5	5	17	0	8	24	5	0	0	0
051-100	62	14	9	27	0	76	10	0	8	9	66	33	0	0	0
101-150	28	52	33	9	0	19	65	0	8	0	10	62	8	50	0
151-200	0	29	50	64	45	0	20	75	17	25	0	0	92	50	83
201-250	0	0	8	0	55	0	0	8	42	58	0	0	0	0	17
251-300	-	-	-	-	-	0	0	0	25	0	-	-	-	-	-
REGION 3															
Width (cm)	Normandin*					Kapuskaing									
	92	93	94	95	96	92	93	94	95	96					
001-050	75	100	-	-	-	10	5	0	0	0					
051-100	25	0	-	-	-	90	70	18	0	27					
101-150	-	-	-	-	-	0	25	82	100	55					
151-200	-	-	-	-	-	0	0	0	0	18					
201-250	-	-	-	-	-	-	-	-	-	-					
251-300	-	-	-	-	-	-	-	-	-	-					

*At Normandin, all plants were died after the second winter.

AMORPHA FRUTICOSA

VAR. TENESSENSIS (SHUTTLEW.)

Family:	Fabaceae
English name:	Bastard Indigo
French name:	Amorpha
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub with an upright habit and stems that curve inwards and downwards slightly can reach a height of 2 m and a spread of 1.5 m. Although this variety is less vigorous than the species itself, it has similar characteristics.

The young stems growing at the base have very vigorous annual growth. They are numerous and slightly pubescent. The slender branchlets, ranging in colour from reddish brown to grey, bear fine lines. The smooth grey bark takes on a brownish cast with age and has prominent lenticels.

The small ovoid buds are reddish brown and downy or almost woolly.

The light foliage is very dense. The compound leaves (21 to 35 leaflets) are alternate; they are light green in summer and turn yellow in fall. Elliptical, acuminate and slightly tomentose, the leaflets are 1 to 2 cm long.

Flowering beings in mid-June after leaf-out. The inflorescences, borne in spikes, are long, cylindrical and narrow. They bear lavender blue flowers.

The seedpods persist through the winter.

The fibrous, shallow roots sometimes form suckers and give the plant good anchorage.

ORIGIN AND DISTRIBUTION

This natural (geographic) variety was identified by Shuttlew. It has been cultivated since 1848 and is indigenous to Tennessee. It ranges from North Carolina to Florida and west to Kansas and Texas.

USE

Ornamental: An ideal choice for poor locations, this plant can be used as a specimen or in massings, and is favoured for its lightness and its beautiful flowers. Its fruits persist through the winter, making it an ideal addition to winter gardens.

REQUIREMENTS

This plant is not very exacting and will grow on poor soils. Indifferent to drought and flooding, it prefers sunny exposures. Spring pruning helps to improve its shape and flowering.

DISEASES AND INSECTS

The Réseau d'avertissements phytosanitaires does not list any specific problems for this species.

PROPAGATION

Seeds: The seeds are collected in early fall before they become too hard. They are sowed in a light medium, in a shady spot.

Cuttings: This propagation method is generally carried out using a piece of wood from the base of the parent plant. The cuttings can be heeled in, or placed in storage or a cold chamber for the winter, and then rooted in spring.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were collected on October 4, 1988. The seeds were extracted after allowing the seedpods to dry out and they were then stored in a dry place. On May 10, 1989, they were immersed in hot water (90 °C) and then kept in water at 20 °C for 24 hours. Following this treatment, the seeds were planted 10 mm deep in a Promix® and sand (1:3; v:v) medium and placed in a shade house (63 %). Emergence occurred over a two-week period and mean growth in the first year was 5 cm. The seedlings spent the winter in the propagation cold frame with no special protection. In fall 1990, they were dug up and heeled in. On May 23, 1991, they were transplanted to the nursery. On October 15, they were pulled up, puddled and heeled in again. The survival rate was 100 %. In mid-April 1992, they were packed and placed in the cold store at 4 °C until shipping.

Inclusion in testing network: Young seedlings 20 to 25 cm tall were planted at eight test sites distributed across Quebec and northeastern Ontario. Their winter survival and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed over a five-year period. Details are provided below of the main types of damage that occurred each winter at the different sites.

Region 1

At L'Assomption, all the seedlings suffered frost damage on the old wood during the first winter, frost damage down to the snow cover the following winter and frost damage on the previous year's shoot in the third winter. Frost injury on stem tips was the only damage seen in the fourth winter.

All the seedlings at Sainte-Clotilde exhibited frost injury on the old wood and down to the snow cover in the first two winters. During the last winter, one third of the seedlings

had damage on the old wood and all the other seedlings had damage on the previous year's shoot.

At Saint-Hyacinthe, the aerial portion of all the shrubs was affected right down to the snow cover in the first winter, except one seedling which was not damaged, but died the following year. The stem tips were affected over the following three winters in 67 %, 100 % and 57 % of the seedlings. In addition, the aerial portion of the seedlings was damaged right down to the snow cover in the second winter. Damage on the year-old shoot, the old wood and rodent damage were observed in equal proportions during the last winter.

Region 2

Two seedlings died at each of the sites in this region during the first winter.

At Sainte-Foy, all the seedlings froze right down to the snow cover in the first winter. The following year, 25 % of the seedlings suffered the same type of damage, whereas the aerial portion of all the other seedlings was affected right down to the ground. The year-old shoot was damaged on all seedlings in the third winter. Subsequently, frost damage was observed right down to the ground on all seedlings.

At Deschambault, during the first winter all of the seedlings suffered damage to the previous year's shoots or right down to the ground in equal proportions. The following winter, they all froze right down to the ground surface. Afterward, damage was limited to the year-old shoots in all subjects, except two seedlings, which had frost-damaged stem tips in the fourth winter.

At La Pocatière, the aerial portion of the seedlings was affected right down to the snow cover in 65 %, 63 %, 8 %, 25 % and 50 % of the seedlings during the testing. Damage was observed right down to the ground, after the first four winters, in 30 %, 37 %, 8 % and 9 % of the seedlings. The stem tips were affected in more than half of the shrubs during the last three winters, and the year-old shoot was

damaged in 17 % and 8 % of the seedlings in the fourth and fifth winters.

Region 3

At Normandin, 95 % of the seedlings died the first winter and the only survivor died the following year.

At Kapuskasing, five seedlings died the first winter and all the other seedlings froze right down to the ground level every winter.

Height and width growth

Figures 1 and 2 show the average height and width of the plants after five years of testing at each of the sites in the different regions.

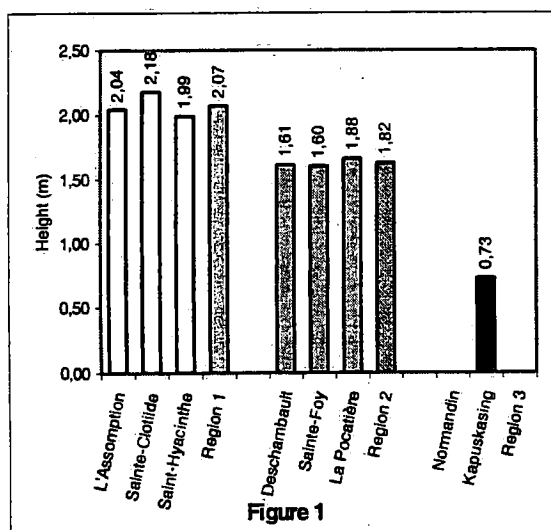


Figure 1. Average height of the shrubs at test completion for the eight sites and the three regions

The heights were especially homogeneous in regions 1 and 2. In region 3, the average includes only the Kapuskasing data, because all of the Normandin shrubs died.

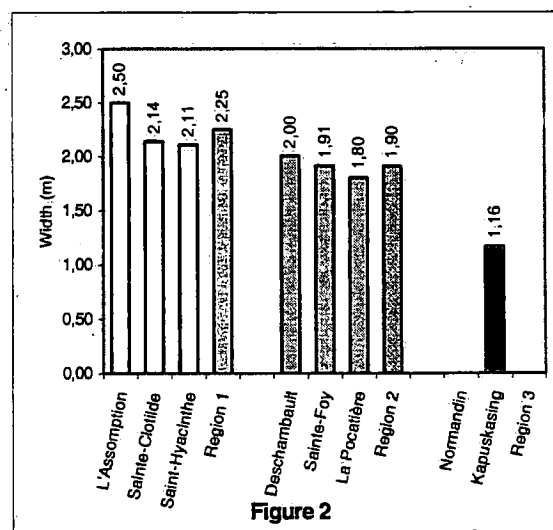


Figure 2. Average width of the shrubs at test completion for the eight sites and the three regions

Effect of pruning

Severe pruning was carried out every year at all the sites, with the stems being cut back by removing 50 % to 90 % of their height. The shrubs at Sainte-Clotilde were pruned only during the final year.

Flowering

At L'Assomption, flowering began between June 13 and 23 during the first two years; flowering began a week earlier at Saint-Hyacinthe. The flowering period varied between 7 and 30 days at the two sites. In region 2, at Sainte-Foy, flowering began between June 19 and 25 and lasted 16 to 33 days, whereas at Deschambault and at La Pocatière, it began a few days earlier, that is, between June 23 and July 15, and lasted for 10 to 33 days. No flowering occurred in region 3.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year according to final height and width classes. Nursery operators will find these tables useful for estimating annual production and the

number of years it should take to obtain a given height and spread.

This variety behaves the same way as the species. The aerial portion of the plant is greatly affected by climatic conditions, and the damage that occurred necessitated drastic pruning every spring at almost all of the test sites.

For production purposes, it is absolutely essential to protect the stems from frost in fall and throughout the winter.

HARDINESS EVALUATION

The hardiness rating assigned to this variety in the literature lies between zones 5 and 7 in the US system, and it behaves in an identical fashion to the species. Although most of the seedlings at Kapuskasing survived, the present test results indicate that this plant's survival is not assured in zone 2, since all the seedlings at Normandin died in the first two winters.

This variety was subjected to severe pruning every spring in zones 4 and 5, but its growth was vigorous and flowering occurred on the current year's wood. Consequently, the use rating can include zone 4.

Full ornamental expression was not observed in the hardiness zones tested.

BIBLIOGRAPHIC REFERENCES

3, 7, 39, 41

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Table 1. Frequency of winter damage observed on *Amorpha fruticosa* var. *tenessensis* (Shuttlew.) from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	20	20		20	20	20					80
Sainte-Clotilde	0			54	25	20		1			100
Saint-Hyacinthe	10	45		7	5	24		2		7	90
REGION 2											
Deschambault	0	4		67			26	3			100
Sainte-Foy	0			18		64	16	2			100
La Pocatière	0	36		5		42	16	1			100
REGION 3											
Normandin	0						5	95			100
Kapuskasing	00						90	10			100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 10 occurred for this species.

Table 2. Breakdown of *Amorpha fruticosa* var. *tenessensis* (Shuttlew.) plants by marketable height category from 1992 to 1996

REGION 1															
Height	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
(cm)	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	0	0	8	0	0	0	0	0	0	0	0	5	0	8	0
051-100	100	25	0	0	0	100	5	8	0	0	86	30	0	0	0
101-150	0	75	84	33	0	0	95	92	25	0	14	65	45	50	0
151-200	0	0	8	67	25	0	0	0	75	66	0	0	55	25	55
201-250	0	0	0	0	75	0	0	0	0	34	0	0	0	17	45

REGION 2															
Height	Deschambault					Sainte-Foy					La Pocatière				
(cm)	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	14	0	0	0	0	10	0	0	0	0	15	0	0	0	0
051-100	86	53	25	8	0	90	32	8	41	8	85	11	0	0	0
101-150	0	47	75	84	25	0	68	58	17	9	0	89	100	100	17
151-200	0	0	0	8	75	0	0	34	42	83	0	0	0	0	83
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

REGION 3															
Height	Normandin*					Kapuskaing									
(cm)	92	93	94	95	96	92	93	94	95	96					
001-050	14	0	-	-	-	29	25	0	0	38					
051-100	86	100	-	-	-	71	75	75	62	37					
101-150	-	-	-	-	-	0	0	25	38	25					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

*All plants were dead after second year.

Table 3. Breakdown of *Amorpha fruticosa* var. *tenessensis* (Shuttlew.) plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	0	0	8	0	0	0	0	0	0	0	14	0	0	8	0
051-100	10	0	0	0	0	43	5	0	0	0	38	15	0	0	0
101-150	90	70	8	0	0	57	15	0	0	0	48	35	0	0	0
151-200	0	30	84	0	0	0	80	25	42	25	0	50	55	9	45
201-250	0	0	0	100	42	0	0	67	58	75	0	0	45	58	55
251-300	0	0	0	0	58	0	0	8	0	0	0	0	0	25	0
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	10	10	0	0	0	10	0	0	0	0	15	5	0	0	0
051-100	76	0	0	0	0	47	11	8	8	8	80	32	0	0	0
101-150	14	74	33	9	0	43	57	0	0	0	5	58	8	42	17
151-200	0	16	67	58	50	0	32	67	17	25	0	5	83	50	67
201-250	0	0	0	33	50	0	0	25	67	67	0	0	9	8	16
251-300	-	-	-	-	-	0	0	0	8	0	-	-	-	-	-
REGION 3															
Width (cm)	Normandin*					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-050	52	100	-	-	-	10	19	0	0	13					
051-100	48	0	-	-	-	90	37	25	0	37					
101-150	-	-	-	-	-	0	44	62	75	25					
151-200	-	-	-	-	-	0	0	13	25	12					
201-250	-	-	-	-	-	0	0	0	0	13					
251-300	-	-	-	-	-	-	-	-	-	-					

*All plants were dead after second year.

ARONIA ARBUTIFOLIA

(L). PERS.

Family:	Rosaceae
English name:	Red Chokeberry
French name:	Aronia
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This suckering shrub, which has an upright ovoid habit when young, can grow to 2 m in height and width.

The outside branches are arching and the young twigs are tomentose.

The alternate leaves are dentate, oval to elliptic in shape and acuminate at the apex, ranging from 4 cm to 8 cm long. The undersides of the leaves are covered with a greyish down. The rather sparse foliage is dark green, turning red in fall.

Flowering occurs in May or June depending on the region and year. The small white flowers, which turn pinkish as they unfold, form corymbs of 9 to 20 flowers. The peduncles and pedicels are pubescent.

The fruit, a pear-shaped pome, turns red in September or October, remaining on the plant well into winter.

The fibrous, creeping roots tend to sucker. Growth is relatively slow.

ORIGIN AND DISTRIBUTION

The species was introduced in North America around 1700. It is found in the United States, from Massachusetts to Florida and, in the west, as far as Minnesota, Ohio, Arkansas and Texas.

USE

Ornamental: The species is used in mass plantings of shrubs or perennials. Its brilliant red colour makes it very attractive in fall.

Naturalization: The species is well adapted to cool, damp habitats along streams, where it grows in colonies. The edible fruit, which persists into winter, attracts birds in winter. Unfortunately, it is also very attractive to browsing field mice.

REQUIREMENTS

This species grows equally well in full sun and light shade. Although it prefers peaty soils, it is not demanding and adapts well to all soil types. However, it grows best in a cool, moist but well-drained soil. Pruning, which is optional, should be done after flowering to promote branching or to freshen up a specimen.

DISEASES AND INSECTS

To our knowledge, the only pest affecting this species is fireblight (*Erwinia amylovora*).

PROPAGATION

Seeds: Propagation from seed seems to be the most successful method. The fruit must be well ripened and the pulp must be removed before the fruit becomes dry and hard. A stratification period of 120 days is required.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were harvested on September 27, 1988. The pericarp was allowed to rot and the seeds were then extracted and put in storage. On January 11, 1989, the seeds were placed in wet peat moss

at 5 °C. On May 12, they were planted 10 mm deep in a Promix® and sand (1:2; v:v) medium and shaded with a cloth (63 %). Sprouting occurred over a period of roughly ten days. The seedlings were kept in a bed until October 15, 1990, and then were dug up and heeled in for winter. On May 22, 1991, they were transplanted to the nursery and treated weekly with a soluble fertilizer (20-20-20, 200 ppm) until the end of August. In autumn, they were dug up, puddled and heeled in. In mid-April 1992, they were wrapped and stored in a cellar to await shipping.

Inclusion in testing network: Young seedlings 15-20 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, all seedlings suffered frost injury to the branch tips during the first winter. The only subsequent damage was rodent depredation during the fifth winter.

At Sainte-Clotilde, three seedlings died the first winter and another the fourth winter. All seedlings suffered frost damage to the one-year-old shoots during the first winter. Three seedlings suffered frost damage to the branch tips the following winter.

Three seedlings died at Saint-Hyacinthe, two during the third winter and one during the fourth winter. Almost all seedlings suffered frost damage to the branch tips during the first two winters.

Region 2

In Sainte-Foy, the first winter, all seedlings suffered frost damage down to the snow cover. Frost damage to the branch tips occurred during the following two winters. During the fourth winter, 33 % of seedlings suffered frost damage to the branch tips and 33 % suffered from rodent damage. During the last winter, 66 % of seedlings were damaged by the weight of the snow.

At Deschambault, varying numbers of seedlings suffered frost damage to the branch tips during the first four winters. In the first two winters, one seedling and two seedlings respectively suffered frost damage to the one-year-old shoots. During the last winter, all seedlings suffered mechanical breakage from the weather.

One seedling died during the fourth winter at La Pocatière. Frost damage to the one-year-old shoots was observed in 5 % , 63 % , 50 % and 5 % of seedlings during the first two and the last two winters. Almost all the other seedlings suffered frost damage to the branch tips. One seedling suffered breakage during the last winter.

Region 3

At Normandin, no damage occurred during the first, third and fourth winters, except for three seedlings that suffered breakage during the third winter. All seedlings had frost damage to the branch tips the second winter and suffered mechanical breakage due to weather conditions during the last winter.

At Kapuskasing, no seedling survived for more than four years. Frost damage to one-year-old shoots was observed in 69 % , 100 % and 18 % of seedlings during the first three winters.

Height and width growth

Figures 1 and 2 show the mean height and width of plants after five years of testing at each site in the three regions.

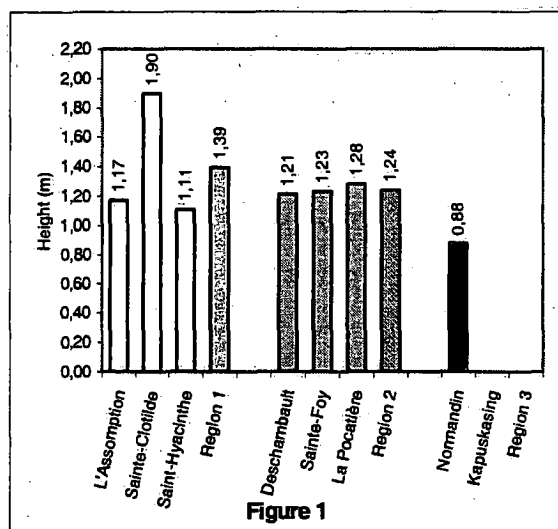


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

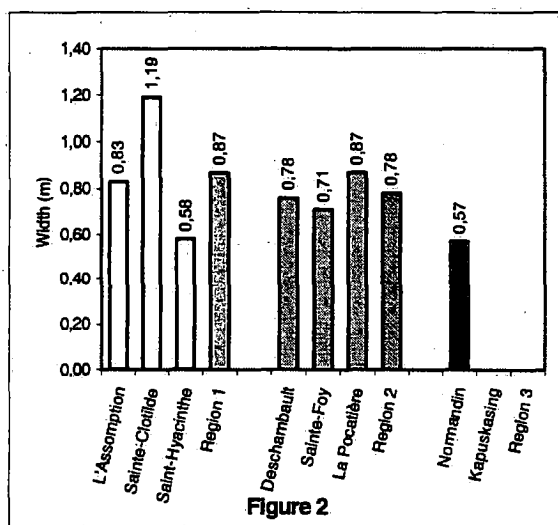


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Effect of pruning

No pruning was done at Sainte-Clotilde. At all the other region 1 sites and at region 2 sites, only minimal pruning was done. In region 3, an average of 60 % of the shrubs' annual growth had to be pruned.

Flowering

At L'Assomption, flowering began every year between June 4 and 6, lasting 10 to 11 days. At Saint-Hyacinthe, flowering began earlier, between May 15 and May 30, lasting for between 16 and 29 days, while at Sainte-Clotilde, it began on May 31 and lasted for 16 days. In region 2, the first flowers generally appeared in mid-June (between June 5 and 21 depending on the year). Flowering lasted from 8 to 11 days, except at Sainte-Foy, where it lasted 21 days. In region 3, the Normandin plants flowered the last year only, around June 10, for a period of 9 to 11 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

La Pocatière and Sainte-Clotilde had the most success in terms of obtaining shrubs taller than 1 m after three growing seasons was at, where, after three years, 75 % and 55 % of shrubs were in this height class. A fourth year was required at Sainte-Foy to obtain shrubs of similar height, and a fifth year at all the other sites, except Kapuskasing.

Regardless of annual height growth, plants grown in the Quebec City region were exposed more to frost damage and mechanical breakage from the weight of the snow.

HARDINESS EVALUATION

According to the literature, this species is hardy to zone 4b or zone 5. The test results show that it can survive as far as zone 2b and can also be used as far as zone 2b.

However, the frost damage and mechanical breakage observed in regions 2 and 3 decrease its potential for use in situations where only minimum maintenance and winter protection can be provided.

The species' full ornamental potential was not achieved at the sites tested.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 9, 28, 31, 33, 34, 39, 41

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Aronia arbutifolia* (L.) Pers. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		1	2	3	4	5	6	7	8	10	
REGION 1											
L'Assomption	73	20								7	27
Sainte-Clotilde	74	4		16				6			26
Saint-Hyacinthe	57	33			3			5		2	43
REGION 2											
Deschambault	19	58		3					20		81
Sainte-Foy	15	45				20			14	6	85
La Pocatière	3	68		25				2	2		97
REGION 3											
Normandin	55	20							25		45
Kapuskasing	0	4		47			1	48			100

^a Key:

1 = no damage

2 = damage to the tip of the previous year's shoot

3 = frost damage on the flower buds

4 = previous year's shoot affected

5 = old wood affected

6 = dead down to the level of snow cover

7 = dead down to the ground surface

8 = dead

9 = sunscald, trunk spitting

10 = mechanical breakage related to weather conditions

11 = damage by rodents

No damage of type 3 and 9 occurred for this species.

Table 2. Breakdown of *Aronia arbutifolia* (L.) Pers. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	30	0	0	0	0	30	6	0	0	0	6	44	36	20	22
051-100	70	100	83	59	8	70	88	45	0	0	94	56	64	70	11
101-150	0	0	17	41	92	0	6	55	37	0	0	0	0	10	56
151-200	-	-	-	-	-	0	0	0	63	60	0	0	0	0	11
201-250	-	-	-	-	-	0	0	0	0	40	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	89	17	0	0	0	68	42	0	0	0	79	0	0	0	0
051-100	11	83	100	100	8	32	50	100	0	0	21	84	25	17	9
101-150	0	0	0	0	84	0	8	0	100	100	0	16	75	83	91
151-200	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-050	12	6	8	0	0	100	100	100	100	-					
051-100	88	94	92	100	100	-	-	-	-	-					
101-150	0	0	0	0	0	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

*At Kapuskasing, data were collected until 1995.

Table 3. Breakdown of *Aronia arbutifolia* (L.) Pers. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	90	40	0	8	0	100	50	9	0	0	100	56	36	30	33
041-080	10	60	100	75	59	0	50	73	18	0	0	44	64	70	67
081-120	0	0	0	17	41	0	0	18	82	70	-	-	-	-	-
121-160	-	-	-	-	-	0	0	0	0	20	-	-	-	-	-
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	77	17	8	0	89	42	0	0	0	100	16	0	0	0
041-080	0	23	83	92	75	11	58	100	100	83	0	84	83	50	27
081-120	0	0	0	0	25	0	0	0	0	17	0	0	17	50	73
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapusasing*									
	92	93	94	95	96	92	93	94	95	96					
001-040	94	29	17	0	0	100	100	100	100	-					
041-080	6	71	83	92	100	-	-	-	-	-					
081-120	0	0	0	8	0	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					
161-200	-	-	-	-	-	-	-	-	-	-					

*At Kapuskasing, data were collected until 1995.

BETULA TIANSHANICA RUPR.

Family:	Betulaceae
English name:	Tien'Chan Mountain Birch
French name:	Bouleau des monts Tien'Chan
Category:	Deciduous plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

This tree has an upright habit. The maximum height that it can attain in Quebec is not known. However, at the Sainte-Clotilde site, some trees were more 7 m tall after seven years of growth.

The bark is white, with a pink interior, which makes the tree very decorative when it exfoliates.

The pointed, incurved buds are made up of overlapping blackish brown scales.

The foliage, dark green and glossy, consists of alternate, simple triangular-shaped leaves. The glabrous blades have a toothed margin and are 3 to 6 cm long. In fall, the leaves turn a beautiful light yellow colour.

In autumn, this monoecious species already bears some inflorescences on the branchlets. They open up beginning in late April and form long pendulous catkins, enhancing the tree's slightly weeping habit.

The fruits, small winged achenes, are grouped in cylindrical cones which are 2 to 3 cm long.

The roots are fasciculated and creeping.

ORIGIN AND DISTRIBUTION

This species, whose name was first published in 1972, comes from the mountains of Asia Minor and has been cultivated for a very long time. It was introduced to North America only recently.

USE

Ornamental: This species can be planted as an accent tree or in groups. Its decorative bark makes it a highly prized specimen for winter gardens.

REQUIREMENTS

This tree grows well in light, sandy soils as well as in poor, moderately wet soils, but dislikes compact and poorly drained soils. It needs full sun for good growth. The tree should be transplanted as a root ball in the spring.

Sensitive to salt spray, this plant should not be planted near streets that have heavy traffic.

Its fragile and brittle wood makes it especially vulnerable during ice storms.

DISEASES AND INSECTS

The foliage attracts the birch miner (*Fenusa pusilla*) and aphids.

In urban settings, yellow-bellied sapsuckers may cause damage by drilling rows of tiny holes into the trees to obtain sap. This damage reduces the tree's vigour.

PROPAGATION

Seeds: This technique ensures the best results. The seeds are sowed immediately after collection and emergence usually occurs six to eight weeks later. Close transplanting is strongly recommended in order to obtain straight stems. The seeds have to be aerated and dried prior to storage.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: The seeds were collected in fall 1988 from parent plants aged 25 years or so. They were

sowed right away in flats placed outdoors. In spring 1990, 240 seedlings were planted in cavities of 110 cm³ each, planted in a bed and treated weekly with a soluble fertilizer (20-20-20, 400 ppm nitrogen). They spent the winter in a cold frame covered by a sheet of plywood. In spring 1991, 220 seedlings were potted in Fertil Pot® containers and held under the same conditions again. The winter survival rate was 100 %. They were packed and shipped on May 5, 1992.

Inclusion in testing network: Young seedlings 32 cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Their winter survival and their growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed over a five-year period. Details are provided below of the main types of damage that occurred each winter at the different sites.

Region 1

At L'Assomption, only one seedling suffered frost damage to the stem tips in the first winter, and another seedling exhibited sun scald damage during the last winter. No further damage was observed subsequently.

At Sainte-Clotilde, one seedling died in the second winter and another suffered frost damage to the year-old wood during the same winter. No other damage occurred subsequently.

No damage occurred at Saint-Hyacinthe.

Region 2

No damage occurred in this region, except at Sainte-Foy where two seedlings suffered mechanical breakage during the last winter.

Region 3

At Normandin, 33 % of the seedlings suffered frost damage to the stem tips during the second winter. No other damage occurred subsequently.

At Kapuskasing, one seedling died the second winter and two seedlings suffered breakage during the first winter.

Height and trunk diameter growth

Figures 1 and 2 show the average height and trunk diameter of the plants after five years of testing at each of the sites in the different regions.

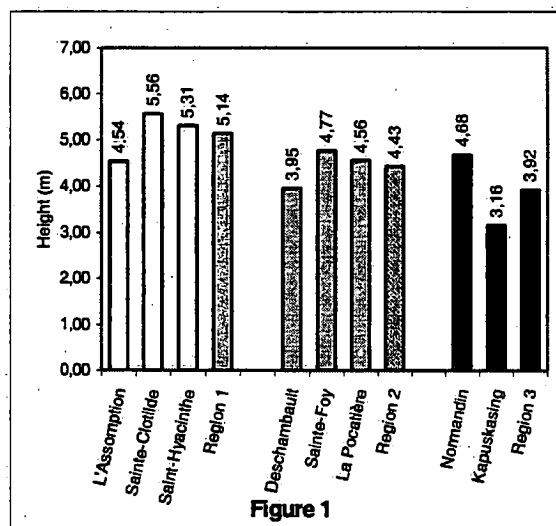


Figure 1. Average height of the trees at test completion at the eight sites in the three regions

The growth rate was particularly good at the Sainte-Clotilde and Saint-Hyacinthe sites.

Trunk diameter was very homogeneous within all the regions.

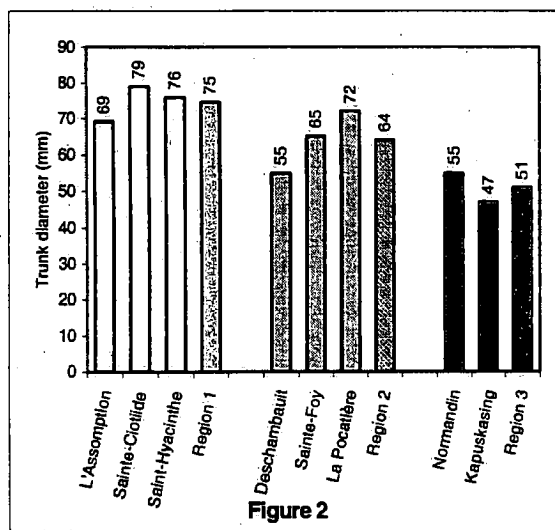


Figure 2. Average trunk diameter of the trees at test completion at the eight sites in the four regions

Effect of pruning

No pruning was carried out on the seedlings, except the removal of broken stems.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test sites, for the final height and trunk diameter obtained after each year. Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and diameter.

After three years of production, more than 80 % of the trees at Sainte-Clotilde, Saint-Hyacinthe and La Pocatière had attained a trunk diameter ranging from 41 to 80 mm. It took a fourth year for the seedlings at L'Assomption and Sainte-Foy to reach a comparable diameter and a fifth year for the seedlings at other sites.

After three years of growth, all the trees in region 2 and at the Sainte-Clotilde and Saint-Hyacinthe sites had attained a height greater than 1.51 m. It took another year at the other sites to obtain trees of comparable height.

This species can be grown throughout Quebec, but its growth rate was faster at the sites in regions 1 and 2. Heavy snowfall can cause breakage.

HARDINESS EVALUATION

The species' hardiness is not known in Canada, since the plant is held exclusively in collections. The results clearly showed, however, that the species suffered very little winter damage due to frost at all sites.

This species showed full expression of its ornamental characteristics at all sites tested; hence, it is believed that it can survive and be used in a zone colder than zone 2a.

BIBLIOGRAPHIC REFERENCES

3, 4, 6, 7, 28, 31, 65

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Betula tianschanica* Rupr. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	97	1						2			3
Sainte-Clotilde	98		1				1				2
Saint-Hyacinthe	100										0
REGION 2											
Deschambault	100										0
Sainte-Foy	97								3		3
La Pocatière	100										0
REGION 3											
Normandin	93	7									7
Kapuskasing	97						1		2		3

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6, 7 and 11 occurred for this species.

Table 2. Breakdown of *Betula tianschanica* Rupr. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-150	100	48	92	0	0	100	19	0	0	0	95	90	0	0	0
151-300	0	52	8	25	0	0	81	50	0	8	5	10	25	8	0
301-450	0	0	0	75	42	0	0	50	50	50	0	0	75	59	8
451-600	0	0	0	0	58	0	0	0	50	42	0	0	0	33	75
601-750	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-150	100	33	0	0	0	100	14	0	0	0	100	29	0	0	0
151-300	0	67	92	42	17	0	81	50	0	0	0	71	17	0	8
301-450	0	0	8	58	50	0	5	50	83	42	0	0	83	75	25
451-600	0	0	0	0	33	0	0	0	17	50	0	0	0	25	67
601-750	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-150	100	14	67	8	0	100	100	25	0	0					
151-300	0	86	33	92	0	0	0	75	67	33					
301-450	0	0	0	0	100	0	0	0	33	67					
451-600	-	-	-	-	-	-	-	-	-	-					
601-750	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Betula tianschanica* Rupr. plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	50	8	0	100	76	17	0	0	100	90	17	0	0
041-080	0	0	50	92	67	0	24	83	82	64	0	10	83	92	58
081-120	0	0	0	0	33	0	0	0	18	36	0	0	0	8	42
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	83	42	17	100	100	42	25	8	100	100	8	0	0
041-080	0	0	17	58	83	0	0	58	75	75	0	0	92	100	92
081-120	-	-	-	-	-	0	0	0	0	17	0	0	0	0	8
Trunk diameter (mm)	REGION 3														
	Normandin					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	100	100	75	0	100	100	100	67	17					
041-080	0	0	0	25	100	0	0	0	33	83					
081-120	-	-	-	-	-	-	-	-	-	-					

BUXUS MICROPHYLLA

'GREEN GEM'

Family:	Buxaceae
English name:	Green Gem Little Leaf Boxwood
French name:	Buis à petites feuilles 'Green Gem'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small, compact shrub, of naturally rounded habit, can grow to 75 cm tall and wide when protected in winter.

The stemwood is hard and greyish.

The dense, light green evergreen foliage consists of small opposite entire leaves, oval in shape and short-petioled. The leaves are smaller than in the cultivars 'Green Mountain' and 'Green Mound'.

The unisexual, apetalous flowers are inconspicuous, forming small clusters in the leaf axils in spring. The female flower, composed of six petals and three carpels, often occurs singly, surrounded by several male flowers, composed of four sepals and four stamens.

The fruits are small, three-valved capsules, containing two black, shiny seeds.

Roots are sparse.

ORIGIN AND DISTRIBUTION

This hybrid comes from Sheridan Nurseries, Ontario. The species is native to northern China and Japan and was introduced in the US around 1860. There are around thirty species of *Buxus*, native to Europe, East Asia and the Americas.

USE

Ornamental: This shrub is extremely well suited to formal beds, with their precise geometric patterns. It can also be used in rock gardens, borders and low hedges.

REQUIREMENTS

The species grows equally well in sunny, partially shaded and shaded locations. Undemanding, it thrives in all types of soils, even poor ones, as long as they are well drained (the roots dislike excess moisture). In cold areas with little snow cover, winter protection is required. Pruning is optional, except for the removal of winter-damaged portions. *Buxus* is suited to topiary.

DISEASES AND INSECTS

Although a number of insects and diseases are associated with the genus *Buxus*, none are specific to this variety.

PROPAGATION

Cuttings: Cuttings root easily at any season. Good results have been obtained with a 1,000-ppm IBA solution and a substrate of equal parts of perlite and peat moss.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Sheridan Nurseries (Ontario)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 420 cuttings (70 mm) were taken on July 19, 1988 from parent plants around 10 years old and measuring 40 cm tall and 30 cm wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. They were planted in Garden Packs[®] filled with a peat-perlite mixture (1:2; v:v), and placed under a Mist-A-Matic[®] mist unit. Weekly treatments with a Benomyl[®] fungicide solution were provided throughout the propagation period. The rooting rate was 90 % after eight weeks. The plants were potted up on September 25 and

overwintered in a cold frame. On April 5, 1989, 378 10-cm seedlings were transplanted into pots and grown in a bed for the entire growing season. In October, they were placed in the cold store at 5 °C with supplementary lighting for 10 hours a day. In April, 1990, they were moved to the greenhouse. The survival rate was 73 %, with the losses due to water stress. On May 25, 289 seedlings were transplanted to the nursery. On October 23, they were dug up, puddled and heeled in until the following spring. On April 23, 1991, they were wrapped in plastic bags and kept in the cold store at 5 °C to await shipping in May.

Inclusion in testing network: Seedlings 10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one plant died during each of the first two winters and the fourth winter. The first winter and last two winters, 79 %, 91 % and 100 % of shrubs suffered frost damage to their aerial portions down to the snow cover. The second and third winters, 94 % and 67 % of shrubs exhibited frost damage to the branch tips. In addition, 18 % of shrubs had foliage browning the third winter.

At Sainte-Clotilde, the aerial portions were affected down to the snow cover during the first two winters and the fourth winter in 100 %, 52 % and 67 % of plants. Foliage browning occurred in 100 %, 33 % and 100 % of shrubs during the last three winters.

At Saint-Hyacinthe, one seedling died the first winter. Foliage browning occurred in 95 %, 32 %, 67 %, 83 % and 83 % of plants over the five winters respectively. The second and fifth winters, 68 % and 17 % of shrubs suffered frost damage to the branch tips. In addition, the aerial portions of the plants above the snow cover were damaged in 17 % of shrubs the fourth winter.

Region 2

At Sainte-Foy, 48 %, 81 %, 100 % and 67 % of plants suffered frost damage to their branch tips the first two and last two winters. All shrubs had frost damage to their aerial portions down to the snow cover the third winter and 33 % of shrubs had similar damage the last winter.

At Deschambault, one seedling died the first winter. Over 30 % of seedlings suffered no damage the first three winters and the last winter. The branch tips were damaged in 57 %, 60 %, 92 % and 17 % of seedlings the first two and the last two winters. One seedling showed damage to the one-year-old shoots during each of the second and fourth winters. Rodent damage occurred in 33 % of shrubs the last winter.

At La Pocatière, the only damage that was observed was frost injury to the aerial portions of the plants above the snow cover, which occurred in 52 %, 33 %, 75 %, 67 % and 25 % of plants over the five winters respectively. The remaining plants suffered no damage.

Region 3

At Normandin, 5 % and 18 % of plants died the second and third winters. The first winter, 67 % of plants suffered frost damage to their branch tips while foliage browning occurred in 22 % and 100 % of plants the last two winters. Over 75 % of shrubs showed no damage the second, third and fourth winters.

At Kapuskasing, one shrub died the third winter. Frost damage to the branch tips was observed in 5 %, 67 %, 67 %, 100 % and 9 % of plants over the five winters. Frost

damage to the one-year-old shoots occurred in 14 %, 17 % and 82 % of plants during the second, third and fifth winters. Foliage browning affected 62 % of seedlings the first winter. One seedling was damaged by the weight of snow or ice during each of the first two winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

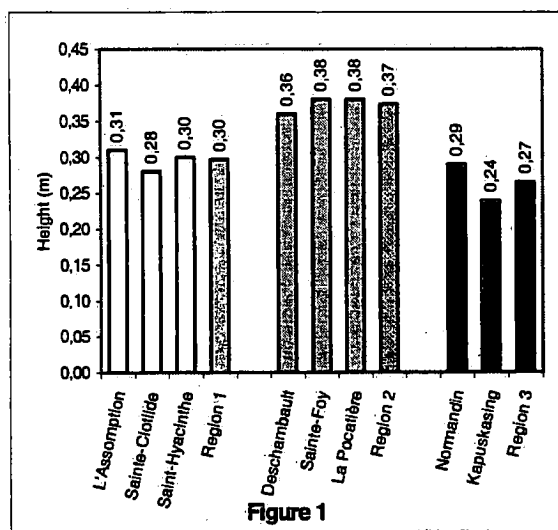


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

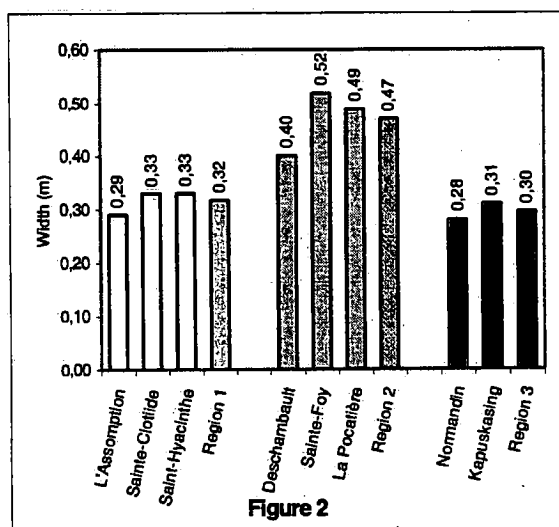


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Regular growth was observed at all sites. The homogeneity of width growth obtained at the sites in each region was remarkable.

Effect of pruning

Only light pruning was done, to deal with winter damage.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After three growing seasons, 90-100 % of shrubs at L'Assomption, Saint-Hyacinthe, Sainte-Foy and La Pocatière had grown to over 21 cm tall, with 75 % of seedlings at Deschambault and Normandin reaching a comparable height in the same time period. Over five years were required at the Sainte-Clotilde and Kapuskasing sites to obtain plants of comparable height.

This cultivar can be produced in regions 1 and 2 and Normandin, as long as sufficient winter protection is ensured.

'Green Gem' had poorer growth than 'Green Mound' and 'Green Mountain', since it is the most compact of the three.

HARDINESS EVALUATION

According to Sherk and Buckley, the species is hardy to zone 5, while our results demonstrated that it could survive as far as zones 4 or 3 (Volume II). Despite frost damage to almost all the plants, the results obtained for the cultivar show that it can survive, and be used, as far as zone 2a, as long as it is protected by sufficient snow cover. Cutting back the damaged shoots will not affect subsequent growth of the shrub.

The cultivar did not achieve its full ornamental potential at the sites tested, since the shrubs had damage every winter.

'Green Gem' had more plants without damage than 'Green Mountain', which may be due to the former's slower growth and smaller size, allowing it to benefit more from the protection of the snow cover.

BIBLIOGRAPHIC REFERENCES

2, 4, 7, 8, 21, 25, 28, 31, 33, 39, 64, 67

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Buxus microphylla* 'Green Gem' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage	
		WINTER DAMAGE ^a											
	1	2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	6	32				54		5				3	94
Sainte-Clotilde	10					44						46	90
Saint-Hyacinthe	7	17				3		1				72	93
REGION 2													
Deschambault	47	45		3				1			4		53
Sainte-Foy	14	59				27							86
La Pocatière	50					50							50
REGION 3													
Normandin	57	14						5				24	43
Kapuskasing	12	49		23				2		2		12	88

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7 and 9 occurred for this cultivar.

Table 2. Breakdown of *Buxus microphylla* 'Green Gem' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	11	11	0	0	0	67	39	17	0	0	-	0	0	0	0
011-020	84	83	9	9	10	33	61	42	50	33	-	63	8	17	0
021-300	5	6	73	82	20	0	0	41	50	25	-	37	92	83	67
031-040	0	0	18	9	70	0	0	0	0	42	-	0	0	0	33
041-050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	14	0	0	0	0	14	0	0	0	0	38	0	0	0	0
011-020	86	80	25	0	0	81	57	0	0	0	62	81	8	0	0
021-300	0	20	75	67	8	5	43	50	42	0	0	19	92	33	0
031-040	0	0	0	33	84	0	0	50	58	83	0	0	0	67	75
041-050	0	0	0	0	8	0	0	0	0	17	0	0	0	0	25
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	29	0	0	0	0	29	10	17	9	0					
011-020	66	100	22	0	0	66	66	25	27	9					
021-300	5	0	78	100	100	5	19	58	64	91					
031-040	0	0	0	0	0	0	5	0	0	0					
041-050	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Buxus microphylla* 'Green Gem' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	100	73	45	10	100	100	83	58	33	-	100	42	0	8
021-040	0	0	27	55	90	0	0	17	42	67	-	0	58	100	75
041-060	-	-	-	-	-	-	-	-	-	-	-	0	0	0	17
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	100	58	8	0	95	86	17	0	0	100	100	17	0	0
021-040	0	0	42	92	50	5	14	83	100	0	0	0	83	100	17
041-060	0	0	0	0	50	0	0	0	0	84	0	0	0	0	83
061-080	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
081-100	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapusking									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	100	44	22	0	100	95	67	36	9					
021-040	0	0	56	78	100	0	5	33	64	73					
041-060	-	-	-	-	-	0	0	0	0	18					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

BUXUS MICROPHYLLA

'GREEN MOUND'

Family:	Buxaceae
English name:	Green Mound, Little Leaf Boxwood
French name:	Buis à petites feuilles 'Green Mound'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This compact, naturally rounded shrub, may grow to 75 cm high and wide given adequate winter protection.

The wood is hard and greyish.

The dense, dark green, evergreen foliage consists of small opposite and entire leaves, oval in shape, with short petioles.

The apetalous unisexual flowers are inconspicuous, forming small clusters in the leaf axils in spring. The female flower, composed of six petals and three carpels, often occurs singly, surrounded by several male flowers, composed of four sepals and four stamens.

The fruits are small, three-valved capsules, containing two black, shiny seeds.

Roots are not numerous.

ORIGIN AND DISTRIBUTION

This hybrid comes from Sheridan Nurseries, Ontario. The species is native to northern China and Japan and was introduced in the US around 1860. There are around thirty species of *Buxus*, native to Europe, East Asia and the Americas.

USE

Ornamental: This shrub is extremely well suited to formal beds, with their precise geometric patterns. It can also be used in rock gardens, beds and low hedges.

REQUIREMENTS

The species grows equally well in sunny, partially shaded and shaded locations. Undemanding, it thrives in all types of soils, even poor ones, as long as they are well drained (the roots dislike excess moisture). In cold areas with little snow cover, winter protection is required. Pruning is optional, except for the removal of winter-damaged portions. *Buxus* is suited to topiary.

DISEASES AND INSECTS

Although a number of insects and diseases are associated with the genus *Buxus*, none are specific to this cultivar.

PROPAGATION

Cuttings: Cuttings root easily at any season. Good results have been obtained with a 1,000-ppm IBA solution IBA and a medium consisting of equal parts of perlite and peat moss.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Sheridan Nurseries (Ontario)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 420 cuttings (70 mm) were taken on July 19, 1988 from parent plants around 10 years old measuring 40 cm tall and 30 cm wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. They were planted in Garden Packs[®] filled with peat moss and perlite (1:2; v:v), and placed under a Mist-A-Matic[®] mist unit. They were treated weekly with a fungicide solution of Benomyl[®] throughout the propagation period. The rooting rate was 90 % after eight

weeks. Plants were potted up on September 25 and overwintered in a cold frame. On April 5, 1989, 378 10-cm seedlings were transplanted to pots and grown in a bed for the entire growing season. In October, they were placed in the cold store at 5 °C with supplementary lighting for 10 hours a day. In April, 1990, they were moved to the greenhouse. The survival rate was 73 %, with the losses caused by water stress. On May 25, 289 seedlings were transplanted to the nursery. On October 23, they were dug up, puddled and heeled in until the following spring. On April 23, 1991, they were wrapped in plastic bags and kept in the cold store at 5 °C to await shipping in May.

Inclusion in testing network: Seedlings 20 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died during the second winter. Frost damage was observed in the aerial portions down to the snow cover in all the plants during the first and last two winters. The second and third winters, 95 % and 58 % of plants suffered frost damage to the branch tips. In addition, 17 % of the shrubs had foliage browning during the third winter.

At Sainte-Clotilde, during the first two winters, one and three seedlings died respectively. During the first two winters and the fourth winter, frost damage was observed in the aerial portions down to the snow cover in 95 %, 85 % and 64 % of plants. Foliage browning occurred in

100 %, 37 % and 72 % of shrubs during the last three winters.

At Saint-Hyacinthe, foliage browning occurred in 100 %, 33 %, 100 %, 100 % and 100 % of plants during the five winters of testing. The branch tips of 67 % of plants were damaged the second winter.

Region 2

At Sainte-Foy, 48 %, 95 % and 100 % of plants suffered frost damage to the branch tips during the first two and fourth winters. Frost damage was observed in the aerial portions of the plants down to the snow cover in all the specimens during the third and fifth winters. In addition, 48 % and 5 % of plants suffered frost damage to the previous year's shoots during the first two winters.

At Deschambault, over 25 % of the plants suffered no damage during the first three years. Frost damage to the branch tips occurred in 38 %, 100 %, 58 %, 75 % and 67 % of plants in each of the five years and 62 % of the plants had damage to the one-year-old shoots during the first winter.

At La Pocatière, the only injuries observed were frost damage to the aerial portion of the plants down to the snow cover, which occurred in 71 %, 52 %, 92 %, 58 % and 75 % of the plants. The other plants did not suffer any damage.

Region 3

At Normandin, two seedlings died the first winter. The second winter, 5 % of the plants suffered frost damage to the branch tips, while foliage browning occurred in 67 % and 100 % of shrubs the last two winters. The second, third and fourth winters, 95 %, 100 % and 33 % of shrubs suffered no damage.

At Kapuskasing, one plant died during the first and third winters. Frost damage to the branch tips was observed in 28 %, 35 %, 45 % and 36 % of shrubs during the first two and last two winters. Frost damage to the one-year-old

shoots occurred in 14 %, 40 %, 92 %, 55 % and 64 % of plants in each winter of the tests. During the first winter, 38 % of the seedlings suffered foliage browning. In addition, 14 % and 10 % of plants were damaged by the weight of snow or ice during the first two winters. One plant suffered frost damage down to the ground level during the second winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years of testing at each site in the three regions.

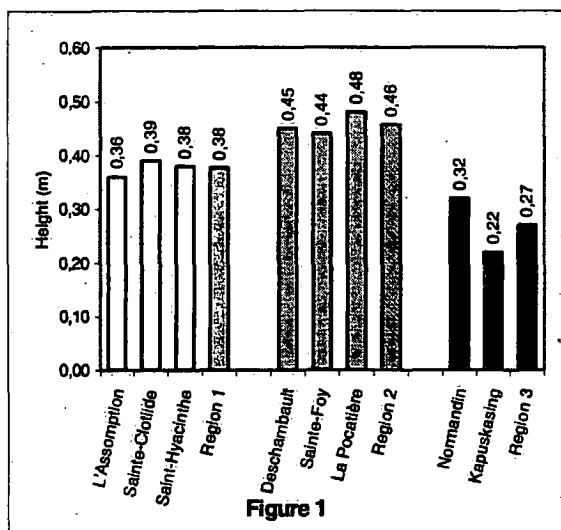


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

Heights were remarkably similar at each site in the various regions.

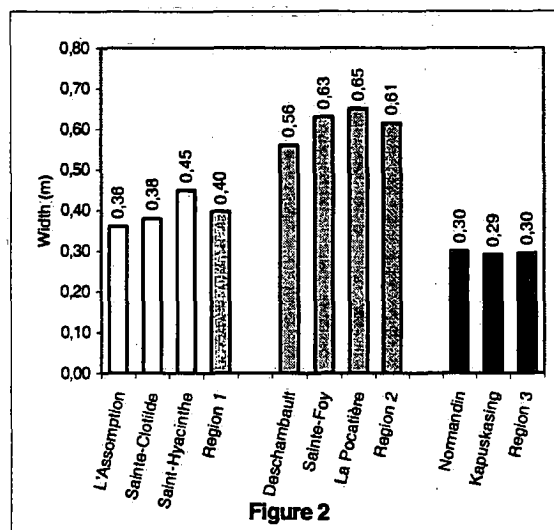


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Effect of pruning

Only light pruning to deal with winter damage was required.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

After two growing seasons, 100 % of the shrubs at Saint-Hyacinthe, Deschambault, Sainte-Foy and La Pocatière had reached a height of over 21 cm, while a third growing season was required at L'Assomption and Sainte-Clotilde to obtain shrubs of comparable height.

This cultivar can be produced in regions 1 and 2 as long as it is given adequate protection against the cold in winter.

Growth in this cultivar is similar to that in 'Green Mountain'.

HARDINESS EVALUATION

According to Sherk and Buckley, the species is hardy as far as zone 5, while our previous results (volume II) showed that the species can survive as far as zone 3 or 4. Despite the presence of frost damage on almost all the seedlings, the results obtained with the cultivar show that it can survive and be used as far as zone 2a, as long as the snow cover provides adequate protection. Removing damaged shoots does not affect subsequent growth of the plant.

The cultivar did not achieve its full ornamental potential at the test sites, with damage to seedlings being observed in all years.

Compared with 'Green Mountain', this cultivar had more undamaged seedlings.

BIBLIOGRAPHIC REFERENCES

2, 4, 7, 21, 25, 31, 33, 39, 64, 67

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Buxus microphylla* 'Green Mound' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
	1	2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	7	31				60		2					93
Sainte-Clotilde	7					53						40	93
Saint-Hyacinthe	0	20						2				78	100
REGION 2													
Deschambault	8	69		17						6			92
Sainte-Foy	3	34		23		40							97
La Pocatière	18					82							82
REGION 3													
Normandin	38	2		20				2				38	62
Kapuskasing	1	33		55			1	3		2		5	99

^aKey:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

No damage of type 3, 5, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Buxus microphylla* 'Green Mound' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	20	30	0	0	0	75	30	0	0	0	-	0	0	0	0
021-040	80	70	91	73	45	20	70	90	36	82	-	86	67	100	18
041-060	0	0	9	27	55	5	0	10	64	18	-	14	33	0	82
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	14	0	0	0	0	10	0	0	0	0	38	0	0	0	0
021-040	86	100	100	25	0	90	90	18	8	8	62	71	50	8	8
041-060	0	0	0	75	100	0	10	82	92	92	0	29	50	92	86
061-080	-	-	-	-	-	-	-	-	-	-	0	0	0	0	6
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	14	96	9	9	9	52	38	36	27	18					
021-040	86	4	91	91	82	48	62	55	73	82					
041-060	0	0	0	0	9	0	0	9	0	0					
061-080	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Table 3. Breakdown of *Buxus microphylla* 'Green Mound' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	95	36	18	0	100	100	45	0	0	-	80	8	0	0
021-040	0	5	64	82	73	0	0	55	100	100	-	20	92	100	27
041-060	0	0	0	0	27	-	-	-	-	-	-	0	0	0	73
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	86	19	0	0	0	100	52	0	0	0	100	80	0	0	0
021-040	14	81	100	33	8	0	48	100	100	8	0	20	100	25	0
041-060	0	0	0	67	17	0	0	0	0	92	0	0	0	75	67
061-080	0	0	0	0	75	-	-	-	-	-	0	0	0	0	33
REGION 3															
Width (cm)	Normandin					Kapusksing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	100	45	36	9	100	71	55	45	18					
021-040	0	0	55	64	91	0	29	45	55	64					
041-060	-	-	-	-	-	0	0	0	0	18					
061-080	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

BUXUS MICROPHYLLA

'GREEN MOUNTAIN'

Family:	Buxaceae
English name:	Green Mountain Little Leaf Boxwood
French name:	Buis à petites feuilles 'Green Mountain'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This compact shrub of pyramidal habit may grow to 1 m in height and width given adequate winter protection.

The wood is hard and greyish.

The dense, dark green, evergreen foliage consists of small opposite and entire leaves, oval in shape, with short petioles.

The apetalous unisexual flowers are inconspicuous, forming small clusters in the leaf axils in spring. The female flower, composed of six petals and three carpels, often occurs singly, surrounded by several male flowers, composed of four sepals and four stamens.

The fruits are small, three-valved capsules, containing two black, shiny seeds.

Roots are not numerous.

ORIGIN AND DISTRIBUTION

This hybrid comes from Sheridan Nurseries, Ontario. The species is native to northern China and Japan and was introduced in the US around 1860. There are around thirty species of *Buxus*, native to Europe, East Asia and the Americas.

USE

Ornamental: This shrub is extremely well suited to formal gardens, with their precise geometric patterns. It can also be used in rock gardens, beds and low hedges.

REQUIREMENTS

The species grows equally well in sunny, partially shaded and shaded locations. Undemanding, it thrives in all types of soils, even poor ones, as long as they are well drained (the roots dislike excess moisture). In cold areas with little snow cover, winter protection is required. Pruning is optional, except for the removal of winter-damaged portions. *Buxus* is suited to topiary.

DISEASES AND INSECTS

Although a number of insects and diseases are associated with the genus *Buxus*, none are specific to this cultivar.

PROPAGATION

Cuttings: Cuttings root easily at any season. Good results have been obtained with a 1,000-ppm IBA solution and a medium consisting of equal parts of perlite and peat moss.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Sheridan Nurseries (Ontario)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (50 mm) were taken on July 28, 1988 from parent plants around 10 years old measuring 35 cm tall and wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. They were planted in Todd® trays filled with peat moss and perlite (1:2; v:v), and placed under a Mist-A-Matic® mist unit. They were treated weekly with a fungicide solution of Benomyl® throughout the propagation period. The rooting rate was 90 % after eight weeks. The plants were potted up on September 25 and overwintered in a

cold frame. On April 5, 1989, 378 10-cm seedlings were transplanted to pots and grown in a bed for the entire growing season. In October, they were placed in the cold room at 5 °C with supplementary lighting for 10 hours a day. In April, 1990, they were moved to the greenhouse. The survival rate was 85 %, with the losses due to water stress. On May 25, 289 seedlings were transplanted to the nursery. On October 23, they were dug up, puddled and heeled in until the following spring. On April 23, 1991, they were wrapped in plastic bags and placed in the cold store at 5 °C to await shipping in May.

Inclusion in testing network: Seedlings 10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, frost damage was observed on the aerial portions down to the snow cover in all seedlings during the first winter and the last two winters. The second winter, two seedlings died while the branch tips of all the other seedlings had frost damage. The same type of injury occurred in 64 % of plants during the third winter.

At Sainte-Clotilde, frost damage was observed in the aerial portions down to the snow cover in 67 % of seedlings during the first winter, and in all the seedlings during the second and fourth winters. Foliage browning occurred in all seedlings during the third and fifth winters.

At Saint-Hyacinthe, one seedling died the fourth winter. Foliage browning occurred in all seedlings during the first

winter and last three winters. The branch tips of all the seedlings were damaged the second winter.

Region 2

At Sainte-Foy, 86 %, 52 % and 33 % of plants suffered frost damage to the branch tips during the first two and fourth winters. In addition, 50 % and 67 % of shrubs suffered frost damage to the one-year-old shoots during the second and fourth winters. Frost damage to the aerial portions down to the snow cover was observed in all the plants during the third and fifth winters.

At Deschambault, frost damage to the branch tips occurred in 14 %, 95 %, 67 %, 100 % and 67 % of plants in each of the five years. The first winter, all the other seedlings had damage to the one-year-old shoots and, the last winter, four plants suffered mechanical breakage.

At La Pocatière, frost damage was observed in the aerial portions down to the snow cover in 60 % to 100 % of the plants every winter.

Region 3

At Normandin, two plants died the second winter. The second and third winters, 80 % to 100 % of the shrubs suffered no damage. However, all plants suffered frost damage to the one-year-old shoots during the first winter and, during the last two winters, foliage browning.

At Kapuskasing, 15 % of plants died the second winter. Frost damage to the branch tips was observed in 33 %, 38 %, 18 %, 64 % and 10 % of plants during the five winters, along with frost damage to the one-year-old shoots in 27 %, 38 %, 82 %, 36 % and 90 % of plants. During the first winter, 24 % of the seedlings suffered foliage browning and one seedling suffered frost damage to the aerial portions down to the snow cover. In addition, during the first two winters, one and two seedlings respectively suffered mechanical breakage.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years of testing at each site in the three regions.

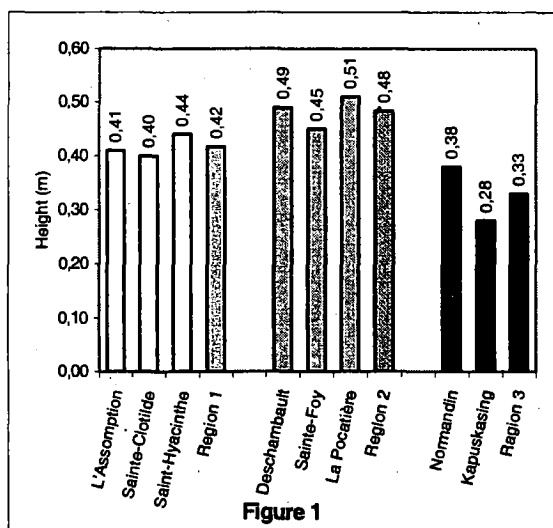


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

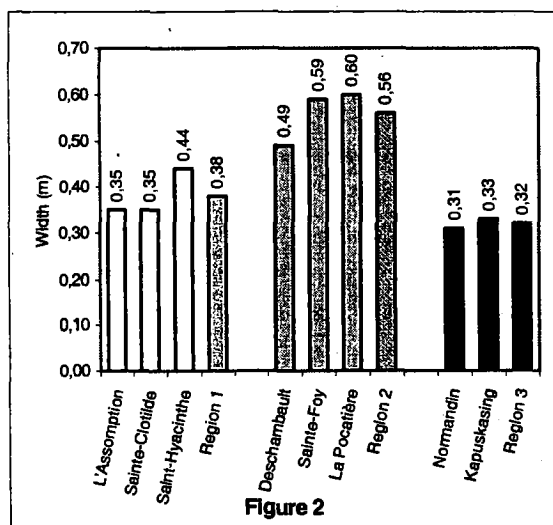


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Heights were particularly homogenous at sites in regions 1 and 2 and widths, at sites in region 3. Steady growth was observed each year at all sites.

Effect of pruning

No pruning was carried out at Sainte-Clotilde. At the other sites, only light pruning was required to remove winter-damaged parts.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

After two growing seasons, 100 % of the plants at Saint-Hyacinthe, Deschambault, Sainte-Foy and La Pocatière had reached a height of 20-40 cm while 70 % of shrubs at L'Assomption and Sainte-Clotilde reached a comparable height.

This cultivar can be produced in regions 1 and 2 as long as it is given adequate winter protection.

Growth in this cultivar is similar to that in 'Green Mound' and quicker than that in 'Green Gem'.

HARDINESS EVALUATION

According to Sherk and Buckley, the species is hardy as far as zone 5, while our previous results (volume II) showed that the species can survive as far as zone 3 or 4. Despite the presence of frost damage in almost all the seedlings, the results obtained with the cultivar show that it can survive and be used as far as zone 2a, as long as the snow cover provides adequate protection. Removing damaged shoots does not affect subsequent growth of the plant.

The cultivar did not achieve its full ornamental potential at the test sites, with damage to seedlings being observed in all years.

BIBLIOGRAPHIC REFERENCES

2, 7, 8, 21, 33, 39, 64; 67

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Buxus microphylla* 'Green Mountain' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
		2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	7	31				60		2					93
Sainte-Clotilde	7					53						40	93
Saint-Hyacinthe	0	20						2				78	100
REGION 2													
Deschambault	8	69		17						6			92
Sainte-Foy	3	34		23		40							97
La Pocatière	18					82							82
REGION 3													
Normandin	38	2	20					2				38	62
Kapuskasing	1	33		55			1	3		2		5	99

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

No damage of type 5, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Buxus microphylla* 'Green Mountain' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	20	30	0	0	0	75	29	0	0	0	-	0	0	0	0
021-040	80	70	91	73	45	20	71	91	36	82	-	86	67	100	18
041-060	0	0	9	27	55	5	0	9	64	18	-	14	33	0	82
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	14	0	0	0	0	10	0	0	0	0	38	0	0	0	0
021-040	86	100	100	25	0	90	90	18	8	8	62	71	50	8	8
041-060	0	0	0	75	100	0	10	82	92	92	0	29	50	92	86
061-080	-	-	-	-	-	-	-	-	-	-	0	0	0	0	6
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	14	96	9	9	9	52	38	36	27	18					
021-040	86	4	91	91	8	48	62	55	73	82					
041-060	0	0	0	0	9	0	0	9	0	0					
061-080	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Table 3. Breakdown of *Buxus microphylla* 'Green Mountain' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	95	36	18	0	100	100	45	0	0	-	80	8	0	0
021-040	0	5	64	82	73	0	0	55	100	100	-	20	92	100	27
041-060	0	0	0	0	27	-	-	-	-	-	-	0	0	0	73
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	52	0	0	0	86	0	0	0	0	100	80	0	0	0
021-040	0	48	100	100	8	14	19	100	33	8	0	20	100	25	0
041-060	0	0	0	0	92	0	81	0	67	17	0	0	0	75	67
061-080	-	-	-	-	-	0	0	0	0	75	0	0	0	0	33
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	100	45	36	9	100	71	55	45	18					
021-040	0	0	55	64	91	0	29	45	55	64					
041-060	-	-	-	-	-	0	0	0	0	18					
061-080	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

CALLUNA VULGARIS

'GOLDEN CARPET'

Family:	Ericaceae
English name:	Golden Carpet Heather
French name:	Bruyère 'Golden Carpet'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub, of spreading, rampant habit, may grow to 0.1 m tall and 0.6 m wide. In winter, it forms a golden carpet speckled with orange and red.

The evergreen, scalelike leaves are opposite and arranged in four imbricate rows. The orangish-yellow foliage is highly decorative.

Flowering begins in August and lasts roughly a month. The flowers have four petaloid sepals longer than the corolla. The inflorescence is in the form of a panicle, made up of small purplish-pink or mauve flowers.

This plant is shallow rooted.

ORIGIN AND DISTRIBUTION

The species is common on sandy heaths with acid soil throughout Western Europe, from Spain to Scandinavia and Russia. The cultivar has been available on the market since 1971.

USE

Ornamental: This shrub is often planted along with rhododendrons and azaleas in beds of acid-loving plants. It is used as a ground cover in mass plantings and rock gardens.

REQUIREMENTS

A very slow grower, this shrub flourishes in an acid soil (pH of 4.5-5.5). It prefers moist, sandy soils. Although it tolerates full sun, it prefers light shade and requires winter protection and shelter from the wind.

DISEASES AND INSECTS

According to the literature, there are few problems with diseases or insects.

PROPAGATION

Cuttings: Traditionally, the shrub is propagated from cuttings in fall, which are overwintered in a cold frame. Cuttings taken in July, treated with a hormone solution and kept under a mist unit, also give good results.

Division: The repent stems take root easily, allowing the plant to be divided after a few growing seasons.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (2-3 cm) were taken on October 19, 1990, from ten-year-old parent plants measuring roughly 10 cm high and 60 cm wide. They were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution, planted in plug trays filled with a peat-perlite mixture (1:1; v:v) and put in the greenhouse under a mist unit operating 8 seconds every 16 minutes. The heating cables were set at 25 °C. Benomyl® fungicide treatments were provided weekly throughout the propagation period. The rooting rate was 50 % after four weeks. Misting was halted and the seedlings were fertilized with a 10-52-10 solution at the recommended rate. The seedlings were potted up on January 9, 1991 in 10-cm pots and treated with a soluble fertilizer (20-20-20). In late May, they were

transferred to a cold frame, where they overwintered without protection. On April 22, 1992, they were wrapped and put in the cold store to await shipping in May.

Inclusion in testing network: Young seedlings 5 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Seedlings died shortly after transplanting at five of the eight sites, killing close to 60 % of seedlings at Saint-Hyacinthe, close to 45 % at Kapuskasing, roughly 30 % at Deschambault and under 10 % at the two other sites.

Region 1

At L'Assomption, some seedlings died every winter, with over a third of the plants dying the first winter and one or two plants the following winters; only four plants survived all five winters of the trial. The only other type of damage observed was frost damage to the branch tips in 80 % of the shrubs during the last winter.

At Sainte-Clotilde, one seedling died the first winter and two others died the third and fifth winters. No other damage occurred.

All seedlings died the first winter at Saint-Hyacinthe.

Region 2

At Sainte-Foy, 30 % and 7 % of seedlings died the first two winters. One plant had frost damage down to the ground level the first winter and two others, the fourth winter. Frost damage to the old wood was observed in 15 %, 10 %, 60 % and 100 % of shrubs the first winter and the last three

winters. The one-year-old shoots suffered frost damage in 25 %, 14 % and 10 % of shrubs the first two winters and the fourth winter. Frost damage to the branch tips occurred in 10 % of plants the first and fourth winters.

At Deschambault, 40 % and 75 % of seedlings died the first and fourth winters, leaving only two plants alive at the end of the trial. Foliage browning was observed in 47 %, 89 %, 25 % and 100 % of plants after the first two and last two winters. Frost damage to the branch tips and to the one-year-old wood affected 37 % and 63 % of shrubs respectively in the third winter.

At La Pocatière, 5 % of seedlings died the first winter. Frost damage to the one-year-old shoots occurred in 30 %, 92 %, 100 % and 100 % of plants the last four winters. In addition, 14 % of seedlings had foliage browning the first winter.

Region 3

At Normandin, plants died each of the five winters, in proportions of 5 %, 30 %, 22 %, 29 % and 60 % respectively, leaving only two plants alive at trial's end. One third of the shrubs had frost damage to the branch tips the second winter. Foliage browning occurred in 22 %, 71 % and 40 % of the plants the last three winters.

At Kapuskasing, 64 % and 100 % of seedlings died the first two winters. In addition, 9 % and 18 % suffered frost damage to the branch tips and one-year-old wood the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

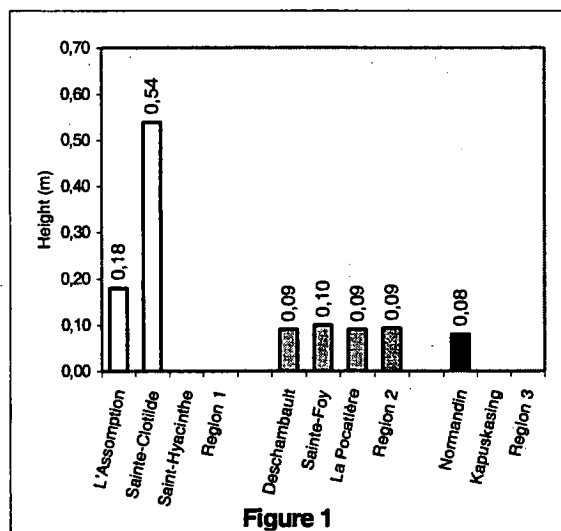


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

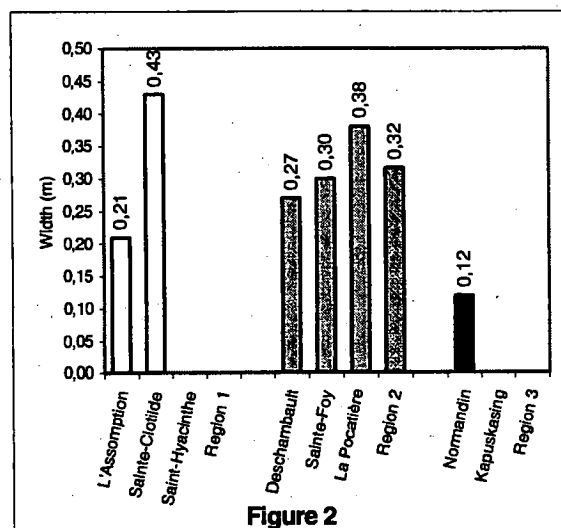


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Height results were very homogenous among sites and regions; the shrubs reached a maximum height of no greater than 20 cm or so by the second growing season.

Effect of pruning

Only light pruning was required at the sites, except at Normandin, where severe pruning had to be done the last three years.

Flowering

Little flowering occurred in region 1; at Sainte-Clotilde, flowering occurred the third year between May 17 and June 2. In region 2, plants flowered yearly at Sainte-Foy and La Pocatière and one year, at Deschambault. Flowering began around the first week of August at Sainte-Foy, around August 10 at La Pocatière and August 15-23 at Deschambault. The duration of flowering was 24-70 days, depending on the year and the site. No flowering occurred in region 3.

PRODUCTION RECOMMENDATIONS

Table 2 indicate the percentage of marketable plants obtained at each test site after each year by width categories (widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given width.

This heather is difficult to grow in most of the regions tested and appreciable growth was only achieved at La Pocatière, Sainte-Foy and Sainte-Clotilde. The production of field-grown plants is not recommended for this cultivar, since growth was very slow and mortality excessive at most of the sites.

The plant can be produced when adequate protection is ensured and the specific requirements of heathers are met. Production is highly specialized.

HARDINESS EVALUATION

There is no mention of the hardiness of the cultivar in the literature (according to the references consulted, the species is hardy to zone 5b). Previous results for certain *Calluna vulgaris* cultivars have shown that survival is

mainly dependent on soil conditions and the presence of an abundant snow cover throughout the cold period. This cultivar proved to be much more delicate than 'Peter Sparkes' and 'Martha Herman', which were evaluated in 1990-95. It can survive as far as zone 4, with the proviso that it may not survive in zone 5 when the snow cover is late getting established in the fall or melts partially or totally during the winter or early spring. Use is recommended in the same zones.

The cultivar did not achieve its full ornamental potential in the regions tested.

BIBLIOGRAPHIC REFERENCES

3, 7, 8, 17, 25, 31, 33

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Calluna vulgaris* 'Golden Carpet' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
		2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	62	16						22					38
Sainte-Clotilde	92							8					8
Saint-Hyacinthe	0							100					100
REGION 2													
Deschambault	5	7		13				23				52	95
Sainte-Foy	37	4		10	37		5	7					63
La Pocatière	32			64				1				3	68
REGION 3													
Normandin	38	6						29				27	62
Kapuskasing	5	5		8				82					95

* Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 6, 9, 10 et 11 occurred for this cultivar.

Table 2. Breakdown of *Calluna vulgaris* 'Golden Carpet' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	100	14	40	100	43	0	10	0	100	-	-	-	-
021-040	0	0	0	86	60	0	57	95	60	67	-	-	-	-	-
041-060	-	-	-	-	-	0	0	5	30	33	-	-	-	-	-
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	93	78	87	50	0	100	93	50	0	10	95	20	0	0	0
021-040	7	22	13	50	100	0	7	50	90	80	5	80	92	83	58
041-060	-	-	-	-	-	0	0	0	10	10	0	0	8	17	42
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-020	90	5	11	14	80	100	100	-	-	-					
021-040	10	35	89	86	20	-	-	-	-	-					
041-060	0	50	0	0	0	-	-	-	-	-					
061-080	0	10	0	0	0	-	-	-	-	-					

*At Saint-Hyacinthe, all plants died the first winter and at Kapuskasing, they were all died after the second winter.

CERCIDIPHYLLUM JAPONICUM

SIEBOLD & ZUCC. EX J. HOFFM. & H. SCHULT.

Family:	Cercidiphyllaceae
English name:	Katsura Tree
French name:	Arbre de Katsura
Category:	Deciduous plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

The only representative of the family Cercidiphyllaceae, this small tree, which tends to be oblong but can also be wide spreading, can reach 7 m in height and 4 m in breadth at maturity. Specimens 10 m tall with a spread of 30 m have been reported to exist in Katsura, Asia.

It has multiple upright-growing stems arising from the ground or from a very short trunk. The thin brown bark turns silvery with age and becomes somewhat shaggy. The slender branchlets bear swellings under the buds.

The conspicuous reddish buds, covered by two scales, are 2 to 4 mm long. There is no terminal bud.

The dense foliage is subtly perfumed in the fall. The leaves are simple, opposite, cordate, rounded and crenelated, and measure 5 to 10 cm long and wide. The blade edge bears small teeth. The colour of the leaves varies with the season: they are purple at leaf-out and take on a bronze to bluish green cast, become glaucous above and light gray below during the summer and change to an orangish yellow in fall.

This dioecious species, with seedlings which are either male or female, flowers before leaf-out and bears small, discreet white flowers on very short branchlets.

The small pod-shaped fruits are 1 to 2 cm long and contain thin winged seeds.

This tree is shallow rooting.

ORIGIN AND DISTRIBUTION

This tree native to Japan and China grows in moist and lightly shaded spots. It was introduced into Europe around 1881. Some specimens were planted in the Dominion Arboretum in Ontario, in 1911.

USE

Ornamental: Used either as a specimen or in mass plantings, this tree imparts a lightness to small spaces and is favoured for its beautiful colours. It is a popular choice for oriental gardens. It is a good example of multi-stemmed trees.

REQUIREMENTS

This species prefers sunny exposures; light shading will diminish its beautiful fall colours.

Katsura tree grows best in a loamy, rich and moist soil. Transplanting entails the use of balled and burlapped stock, and the seedlings must be watered when the soil gets dry.

Since they are frost sensitive, specimens with a bushy habit and multiple leaders are more difficult to tend than those with a single stem. A site sheltered from the wind is best.

The species is not very tolerant of de-icing chemicals and atmospheric pollution.

DISEASES AND INSECTS

According to the references consulted, this species is affected by few disease and pest problems.

PROPAGATION

Cuttings: Woody cuttings taken in February or March, usually yield a high success rate.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Université Laval, Sainte-Foy (Quebec)

Propagation site: Université Laval, Sainte-Foy (Quebec)

Propagation technique: 410 cuttings of 15 cm were taken on June 22, 1990 from parent plants aged about 25 years old. They were soaked for 5 seconds in a 8,000 ppm IBA/50% ethanol solution, and then rinsed with tap water. They were then immersed in a Benomyl-Captan® fungicide solution and placed under mist (Mist-A-Matic®) in a peat and perlite (2:3; v:v) medium. The rooting rate was 60 % after 130 days. Misting was stopped in early October and the seedlings were treated twice with a soluble fertilizer (20-20-20, 200 ppm nitrogen). In November, the seedlings were removed from the containers and stored in a cold room at 0 °C in plastic bags perforated using a pin. In May 1991, they were potted in Fertil-Pot® containers in a peat and perlite (3:2; v:v) medium and placed in a greenhouse tunnel for about a month, after which they were put outside in lightly shaded cold frames. They were treated weekly with a soluble fertilizer (20-20-20, 200 ppm nitrogen) until mid-September. In November, they were returned to the cold storage at -2 °C. In early May 1992, the seedlings were packed and put back into the cold room at 4 °C until shipping, a few days later.

Inclusion in testing network: Young seedlings pruned to a height of 9 cm were planted at eight test sites located throughout Quebec and northeastern Ontario. Their winter survival and their growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

A number of seedlings did not survive transplanting, with 20 % to 100 % of them dying. Since recovery was poor and the losses were high, it was not deemed appropriate to continue the evaluation at the Deschambault, La Pocatière, Normandin and Kapuskasing sites.

Winter damage

Region 1

At L'Assomption, only one seedling survived the testing, with the others succumbing during the first three winters and the last winter. In the second winter, 22 % of the seedlings exhibited frost damage to the old wood and 22 % froze down to the snow cover level. The tips of 39 % of the seedlings were damaged during the first winter.

At Sainte-Clotilde, only five seedlings survived the test, with the others dying during the first three winters. In the first winter, 52 % and 19 % of the seedlings suffered damage to the branch tips and the year-old shoot. The following winter, 60 % of the seedlings froze right down to the snow cover level. No damage occurred during the last two winters.

At Saint-Hyacinthe, four seedlings survived the test; all the others died during the first winter. In addition, 31 % of the seedlings exhibited frost damage to the stem tips in the first winter. No damage occurred during the last four winters.

Region 2

The seedlings at the Deschambault and La Pocatière sites were not evaluated.

In Sainte-Foy, only one seedling survived the test; all the rest died during the first two winters. During the first winter, 54 % of the seedlings suffered frost damage to the year-old shoot, and the only surviving seedling suffered frost damage to the old wood during the second winter. The latter subject was not damaged by frost during the last three winters.

Region 3

The seedlings at the sites in this region were not evaluated.

Height and trunk diameter growth

Figures 1 and 2 illustrate the mean height and diameter of the trees after five years of testing at each of the sites in the different regions.

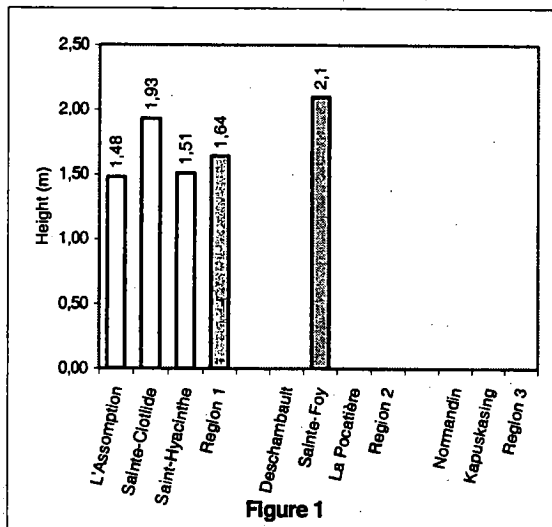


Figure 1. Average height of the trees at test completion at the four sites in the region 1

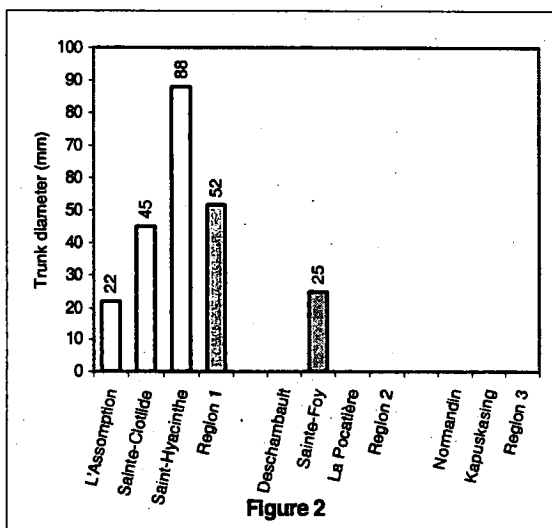


Figure 2. Average trunk diameter at test completion at the four sites in the region 1

Effect of pruning

The seedlings at the L'Assomption and Sainte-Foy sites were severely pruned after the first two winters in

response to frost damage. No pruning was done at the Sainte-Clotilde and Saint-Hyacinthe sites.

PRODUCTION RECOMMENDATIONS

In view of the results obtained, this species is not recommended for production in Quebec given its marginal use.

HARDINESS EVALUATION

The references consulted give a hardiness rating of 5 to this species. However, the two parent plants from which cuttings have been growing in the arboretum of Jardin Roger-Van den Hende, in zone 4b, for over 30 years. These seedlings, which exhibited frost damage during the first winters after outplanting, subsequently adapted and have not exhibited severe damage for some 20 years in spite of some particularly harsh winters.

However, the test results do not allow for an accurate determination of the species' limitations related to survival, use and full expression of ornamental characteristics. Indeed, the seedlings exhibited major problems with recovery, and the mortality observed during transplanting could be linked to a lack of water, since this species is especially vulnerable to drying out.

It appears that this species is more frost-sensitive at a young age.

BIBLIOGRAPHIC REFERENCES

3, 7, 9, 20, 31, 33, 35, 39, 65, 67, 77

PREPARED BY

Claude Richer, Agr.

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Table 1. Frequency of winter damage observed on *Cercidiphyllum japonicum* Siebold & Zucc. ex J. Hoffm. & H. Schult. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	32	18		4	4		42				68
Sainte-Clotilde	51	10	4		15		20				49
Saint-Hyacinthe	80	6					14				20
REGION 2											
Deschambault	-										-
Sainte-Foy	40		11	3			26		20		60
La Pocatière	-										-
REGION 3											
Normandin	-										-
Kapuskasing	-										-

Plants of Deschambault, La Pocatière, Normandin and Kapuskasing were not evaluated.

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 9 occurred for this species.

CHAMAECYPARIS LAWSONIANA

(A. MURR.) PARL.

Family:	Cupressaceae
English name:	Lawson False Cypress
French name:	Cyprès
Category:	Evergreen plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

This broadly conical tree can grow to a height of 30 m in England with a spread of nearly 2 m at the base. However, its shape is highly variable, because the branches may droop to some extent, giving the tree a weeping look. In Canada, mature trees range in height from 10 to 15 m.

The bark is thin, grayish brown and scaly in young trees, but develops narrow, crossing ridges with age.

The many slender branchlets, with quadrangular sections (cupressoid type), have a slightly flattened shape. Young shoots, nearly cylindrical in shape, carry short, partially flattened leaves.

The leaves are pointed at the tip and have a white band on their undersurface. The dark green or bluish green branches which form a spray, gave to the plant a light aspect.

The reproductive organs of this monoecious species are arranged in pairs. Female cones, globose and bluish in colour, reach maturity at the end of the second growing season. In spring, the male cones display a range of colours from pink to red. The spherical cones with their small peduncles measure 8 to 10 mm across and are composed of 8 to 10 mucronated scales, which turn brown at maturity.

The root system may be shallow or deep depending on the type of soil in which the tree is growing.

ORIGIN AND DISTRIBUTION

This tree is native to northwestern California and southwestern Oregon. It was reportedly first introduced into Europe in 1840 when some seeds were sent to the Lawson nursery in Edinburg.

USE

Ornamental: This tree is attractive for large areas because of its size. Size varies widely depending on the provenance and origin of the selected tree.

DISEASES AND INSECTS

In excessively wet habitats, the species is susceptible to canker.

REQUIREMENTS

The tree prefers sunny exposures but will tolerate shadier situations as well. Cultivars with yellow foliage are the only ones that demand a great deal of sunlight. *C. lawsoniana* grows in most soil types, but dislikes calcareous soils. Fairly high humidity (not excessive) is best, although this species is known to be somewhat tolerant of drought. It will benefit from being sheltered from the prevailing winds and from having winter protection.

PROPAGATION

Seeds: Seeds are collected in late summer, shortly before the cones open. Right after the seeds are collected, they are sown in flats and covered with conifer branches. Despite their very low germination capacity (10 %), the seeds of this species do well.

Cuttings: Cuttings are taken from semi-woody stems in July or August, and the rooted cuttings are transplanted in the spring. Growing the cuttings in pots the first year allows a better root system to develop before they are outplanted. Heel cuttings branch more rapidly.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: Seeds were collected in fall 1988 and sowed right away in flats kept outdoors. They germinated in spring 1989. In August 1990, 220 seedlings were potted in Fertil Pot® containers and placed in cold frames for the winter. The cold frames covered by sheets of plywood provided protection, and the winter survival rate was 90 %. The following summer, they were kept in the same place, treated weekly with a fertilizer solution (20-20-20, 400 ppm nitrogen) and subjected to the same winter conditions as during previous winters. On May 5, 1992, they were packed and sent to the test sites.

Inclusion in testing network: Young seedlings 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario. Their winter survival and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

A number of seedlings died during the first winter, including all of the those at L'Assomption, 52 % at Saint-Hyacinthe, 47 % at Kapuskasing and 17 % at Normandin.

Winter damage

Table 1 shows the frequency of winter damage observed over a five-year period. Details are provided below of the main types of damage that occurred each winter at the different sites.

Region 1

At L'Assomption, none of the trees survived the first winter.

At Sainte-Clotilde, 5 % of the seedlings died in each of the first two winters and the eight remaining seedlings died

during the fourth winter. In addition, frost damage occurred on the aerial portion during the second winter and foliage browning during the third winter.

At Saint-Hyacinthe, 51 %, 10 % and 11 % of the seedlings died the first, third and fifth winters. In the second and fifth winters, 90 % of the seedlings exhibited foliage browning. In addition, frost damage to the aerial portion located above the snow cover affected 43 % and 90 % of the seedlings in the first and third winters.

Region 2

At Sainte-Foy, 17 % of the seedlings suffered damage to the stem tips in the fourth winter. Damage to the year-old shoot occurred in 8 % of seedlings during the third winter. During the first and fourth winters, 100 %, 57 % and 33 % of the specimens suffered damage to a portion of stem located above the snow cover.

At Deschambault, one seedling died the third winter. During the last three winters, 31 %, 25 % and 33 % of the seedlings showed exhibited frost damage to the stem tips and 23 %, 67 % and 67 % of the seedlings frost damage to the previous year's shoot. In the first two winters, 100 % and 67 % of the seedlings suffered frost damage to the aerial portion located above the snow cover. During the second winter, 15 % of the trees were also affected by foliage browning.

At La Pocatière, every winter some trees suffered frost damage to stems located just above the snow cover, which affected 100 %, 90 %, 54 %, 27 % and 55 % of the specimens. In addition, 64 % of the seedlings showed foliage browning damage in the fourth winter.

Region 3

At Normandin, 15 % and 5 % of the seedlings died during the first two winters. In addition, during the first winter 86 % of them suffered frost damage to the aerial portion of the plant above the snow cover and the following winter 11 % suffered damage to the stem tips.

At Kapuskasing, some seedlings died during the first three winters, specifically 48 %, 36 % and 29 % of the total. Frost damage to the branch tips occurred in 9 %, 18 %, 40 % and 20 % of the seedlings during the first two winters and the last two winters. The previous year's stems froze on 5 %, 9 %, 28 % and 29 % of the seedlings during the first three winters and the last winter. The stems of 9 % and 42 % of the seedlings froze down to the ground level during the first and third winters. In addition, 27 % of the seedlings exhibited frost damage to the aerial portion of the plant above the snow cover in the second winter.

Height and width growth

Figures 1 and 2 illustrate the average height and diameter of the seedlings after five years of testing at each site in the different regions.

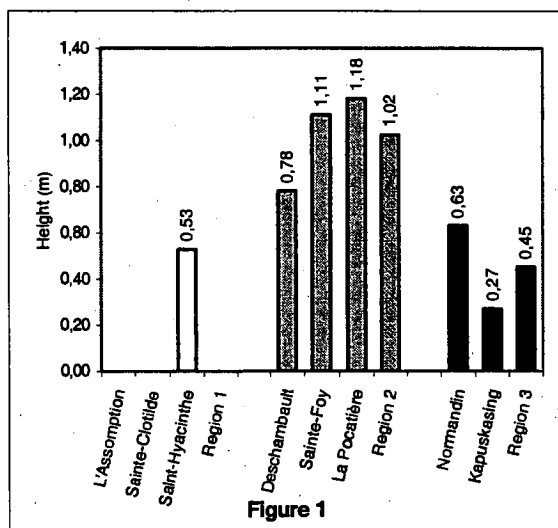


Figure 1. Average height of the trees at test completion at each site in the three regions

Slow, steady growth was observed at all sites during the testing period. Only some of the Saint-Hyacinthe seedlings survived in region 1.

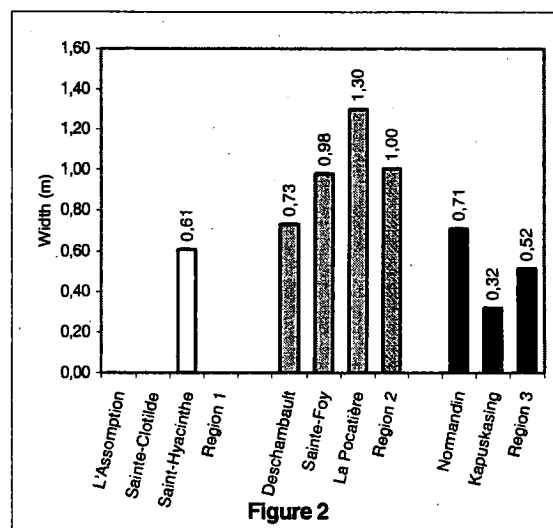


Figure 2. Average width of the trees at test completion at each site in the three regions

Effect of pruning

Pruning was carried out every spring at all the sites in accordance with the severity of winter damage.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test sites, for the final height and width obtained after each year. Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and diameter.

Seedlings survived at a number of sites and, after five years, La Pocatière was the only site with trees taller than 1 m. Although promising growth was seen at the sites in region 1, the seedlings did not withstand the lack of snow.

This species should not be grown without winter protection, since the risk of mortality is much too high under the climatic conditions that exist in Quebec.

HARDINESS EVALUATION

In the US literature, this species is classified as belonging in hardiness zone 5, which corresponds to zones 5b or 6 in the Canadian system. The results of our tests showed that at warmer sites, nearly total mortality occurred, with seedlings dying during every harsh winter. In addition, at each site, frost damage to the aerial portion of the plant above the snow cover level, provided evidence of the vulnerability of the stems to Quebec winters. This gradual mortality can be attributed in part to the elimination of the weakest subjects, with a wide variation being apparent among seed-origin seedlings. Mortality of the seedlings can also be explained by this plant's lack of hardiness.

The survival rate for this species depends on the winter protection that is provided and it can survive in zone 4 if the snow cover provides sufficient protection for the seedlings early in fall and throughout the winter. In addition, only a few specimens naturally selected among the seedlings obtained from the parent plant can adapt to and survive our winter conditions. The losses and damage were so great that the use rating and full ornamental expression cannot be considered to suit the tested zones for young plants. However, the parent plant located at the Botanical Garden of Montreal survived and produces seeds periodically, indicating that some specimens can express a higher than average hardiness potential.

BIBLIOGRAPHIC REFERENCES

3, 7, 27, 31, 35

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Chamaecyparis lawsoniana* (A. Murr.) Parl. from 1993 to 1997

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE*									
	1	2	4	5	6	7	8	10	11	14	
REGION 1											
L'Assomption	0						100				100
Sainte-Clotilde	8				24		28			40	92
Saint-Hyacinthe	3				27		15			55	97
REGION 2											
Deschambault	13	18	31		33		2			3	87
Sainte-Foy	37	3	2		38					20	63
La Pocatière	22				65					13	78
REGION 3											
Normandin	58	2			17		4	3		16	42
Kapuskasing	31	18	13		5	10	22			1	69

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

No damage of type 3, 5, 9 and 11 occurred for this species.

Table 2. Breakdown of *Chamaecyparis lawsoniana* (A. Murr.) Parl. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption*					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	95	-	-	-	-	100	55	0	6	-	90	90	50	56	-
051-100	5	-	-	-	-	0	45	84	89	-	10	10	50	44	-
101-150	-	-	-	-	-	0	0	16	5	-	-	-	-	-	-
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	90	75	25	8	81	100	100	8	0	95	70	8	8	0
051-100	0	10	25	75	83	19	0	0	92	33	5	30	92	84	0
101-150	0	0	0	0	9	0	0	0	0	59	0	0	0	8	100
151-200	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	94	73	18	9	100	100	100	100	100					
051-100	0	6	27	82	91	-	-	-	-	-					
101-150	-	-	-	-	-	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*At L'Assomption, all plants were dead after the first winter and after the fourth winter at Sainte-Clotilde and Saint-Hyacinthe.

Table 3. Breakdown of *Chamaecyparis lawsoniana* (A. Murr.) Parl. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption*					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	-	-	-	-	100	55	11	0	-	100	100	60	11	-
041-080	-	-	-	-	-	0	45	73	50	-	0	0	40	67	-
081-120	-	-	-	-	-	0	0	16	44	-	0	0	0	22	-
121-160	-	-	-	-	-	0	0	0	6	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	86	38	58	25	8	95	100	58	0	0	90	50	8	8	0
041-080	14	62	34	75	58	5	0	42	75	8	10	50	84	0	0
081-120	0	0	8	0	34	0	0	0	17	84	0	0	8	58	27
121-160	-	-	-	-	-	0	0	0	8	8	0	0	0	34	73
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	83	36	9	0	100	82	86	100	60					
041-080	0	17	64	27	91	0	18	14	0	40					
081-120	0	0	0	64	9	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

*At L'Assomption, all plants were dead after the first winter and after the fourth winter at Sainte-Clotilde and Saint-Hyacinthe.

CORNUS ALBA

'ARGENTEO-MARGINATA'

(CONTROL 1991)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Propagation and Bibliographic References have already been published in the second series of factsheets (Publication 02-9303), and the Insects and Diseases section in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume III (VT 008).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 300 cuttings (15 cm) were collected on August 21, 1990 from parent plants roughly 20 years old. They were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution, and then rinsed with tap water. After that the seedlings were immersed in a Benomyl-Captan® fungicidal solution, then planted in plug trays filled with a peat-perlite substrate (1:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 95 % after 40 days. The seedlings were hardened off by reducing the misting; they were then treated with a soluble fertilizer (20-20-20) and stored in an unheated greenhouse. In mid-November, the seedlings were put in plastic bags that had been perforated with a hatpin and placed in the cold store at 0 °C. In early May 1991, the plants were wrapped and returned to the cold store at 4 °C to await shipping a few days later.

Inclusion in testing network: Young seedlings 6 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

At the L'Assomption, La Pocatière and Normandin sites nearly 50 % of the seedlings died following transplanting, whereas about 20 % died at Sainte-Clotilde, Sainte-Foy and Deschambault. However, 25 %, 19 %, 16 % and 2 % of the plants at Sainte-Clotilde, Saint-Hyacinthe, Deschambault and La Pocatière did not establish well during the first season and died the following winter.

Region 1

At L'Assomption, 25 % of the seedlings suffered damage to the branch tips the second winter.

No other damage occurred at Sainte-Clotilde or Saint-Hyacinthe.

Region 2

No damage occurred at Sainte-Foy or La Pocatière during the trial. However, at La Pocatière, the seedlings were greatly impacted by summer drought, which caused severe defoliation.

At Deschambault, 6 % of the seedlings suffered frost damage to the one-year-old shoots the first winter and 9 % of the plants had frost damage to the branch tips the third winter.

Region 3

At Normandin, the only damage was frost injury to the branch tips, which occurred in 72 % and 10 % of the plants during the second and third winters.

At Kapuskasing, frost damage occurred the first winter, killing one seedling and resulting in mechanical breakage to another plant.

Height and width growth

Figures 1 and 2 show the mean height and width of the shrubs after five years at each site in the three regions.

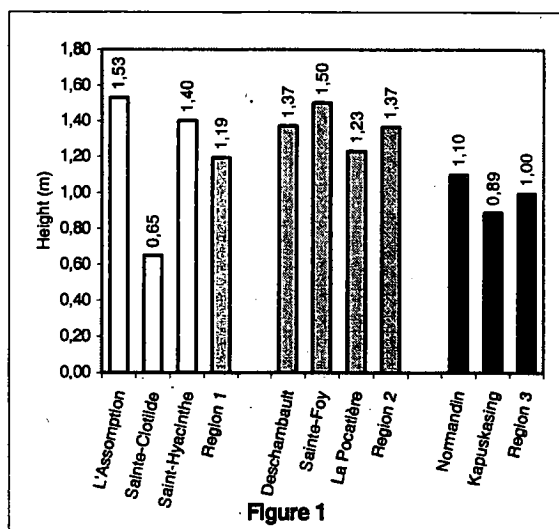


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

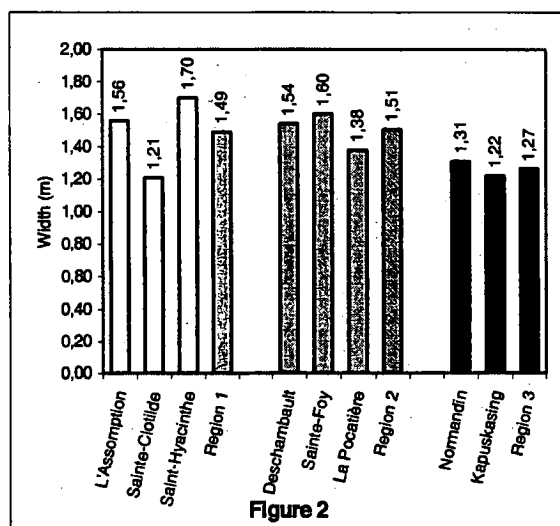


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

The shrubs reached their maximum height as of the fourth year at Sainte-Clotilde, Saint-Hyacinthe, La Pocatière and Normandin. Height increased annually at all other sites.

The shrubs were all slightly broader than tall at trial's end.

Effect of pruning

Light pruning was done at all sites, removing at most one third of the aerial portion of the plants.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Contrary to what was observed in previous years, it took three years for the shrubs to reach a height of 0.51-1.00 m at nearly all the sites. This is attributable to the seedlings' poor recovery after transplanting and the storage conditions for rooted cuttings.

At Kapuskasing, it took five years for all the shrubs to reach that height.

HARDINESS EVALUATION

As in previous trials, little or no mortality occurred in zone 2 and survival is probably assured in zone 1.

The plants can be used and achieve full ornamental potential in zone 2, however, frost damage to the branch tips may occur occasionally.

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Cornus alba* 'Argenteo-marginata' (Control 1991) from 1992 to 1996

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	98							2			2
Saint-Hyacinthe	100										0
REGION 2											
Deschambault	98								2		2
Sainte-Foy	91	7		1				1			9
La Pocatière	98							2			2
REGION 3											
Normandin	77	20							3		23
Kapuskasing	99							1			1

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Cornus alba* 'Argenteo-marginata' (Control 1991) plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	25	0	0	0	100	18	0	0	0	81	5	0	0	0
051-100	0	75	50	25	0	0	82	75	33	25	19	57	25	0	0
101-150	0	0	50	75	33	0	0	25	67	58	0	38	75	100	42
151-200	0	0	0	0	67	0	0	0	0	17	0	0	0	0	58
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	5	0	0	0	100	10	0	0	0	100	0	0	0	0
051-100	0	90	58	33	0	0	90	55	0	0	0	100	10	0	0
101-150	0	5	42	67	83	0	0	45	100	82	0	0	90	100	100
151-200	0	0	0	0	17	0	0	0	0	18	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-050	88	0	0	0	0	100	74	0	0	0					
051-100	12	62	42	0	0	0	26	100	91	75					
101-150	0	38	58	100	100	0	0	0	9	25					
151-200	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Cornus alba* 'Argenteo-marginata' (Control 1991) plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	10	0	0	0	100	12	0	0	0	100	5	0	0	0
051-100	0	90	25	8	0	0	88	42	8	0	0	24	0	0	0
101-150	0	0	67	92	17	0	0	58	83	50	0	66	83	58	42
151-200	0	0	8	0	75	0	0	0	9	50	0	5	17	42	58
201-250	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	10	0	0	0	100	5	0	0	0	100	9	0	0	0
051-100	0	70	25	8	0	0	74	18	0	0	0	91	10	10	0
101-150	0	20	75	84	83	0	21	82	73	73	0	0	90	50	30
151-200	0	0	0	8	17	0	0	0	27	27	0	0	0	40	70
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	0	0	0	0	100	58	0	0	0					
051-100	0	63	33	0	0	0	42	58	8	0					
101-150	0	37	67	83	67	0	0	42	92	75					
151-200	0	0	0	17	33	0	0	0	0	25					
201-250	-	-	-	-	-	-	-	-	-	-					

CORNUS ALBA

'ARGENTEO-MARGINATA'

(CONTROL 1992)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Propagation and Bibliographic References have already been published in the second series of factsheets (publication 02-9303), and the Diseases and Insects section in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume III (VT 008).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 354 cuttings (12 cm) were taken on June 22, 1991 from roughly 20-year-old parent plants. The cuttings were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution and rinsed with tap water. After immersion in a fungicide bath (Benomyl-Captan®), they were planted in a peat-perlite mixture (3:2; v:v) in plug trays and placed under a mist unit (Mist-A-Matic®). The rooting rate was 95 % after 30 days. The seedlings were potted up on July 20 in Fertil Pots® in a peat-perlite substrate (3:2; v:v). They were treated weekly with a soluble fertilizer (20-20-20, 200 ppm nitrogen) until mid-September and kept in an unheated greenhouse. In November, they were moved to the cold store and held there at 0 °C in plastic bags that had been perforated with a hatpin. In May 1992, they were wrapped and kept in the cold store at 4 °C to await shipping a few days later.

Inclusion in testing network: Seedlings 5-10 cm high were planted at eight test sites throughout Quebec and

northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage occurred within this region; however, one plant died at Sainte-Clotilde.

Region 2

In Sainte-Foy, two seedlings died after transplanting and a third died the following year. Frost damage to the branch tips and the one-year-old shoots was the only damage found in 37 % and 5 % of plants during the first winter. No damage was recorded subsequently.

No damage was recorded at Deschambault, except that one shrub sustained mechanical breakage owing to climatic conditions during the fifth winter.

At La Pocatière, 75 % of the seedlings died upon being transplanted and another seedling died after the first winter. No further damage was observed during the trial.

Region 3

At Normandin, five shrubs died following transplanting, but no other damage was recorded. Frost injury to the branch tips occurred in all plants during the second winter. No further damage was noted, except that two shrubs sustained mechanical breakages the last winter owing to the weather conditions.

During the five years of the trial, no damage was observed at Kapuskasing. One seedling died after being transplanted and a second one died during the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the shrubs after five years at each site in the three regions.

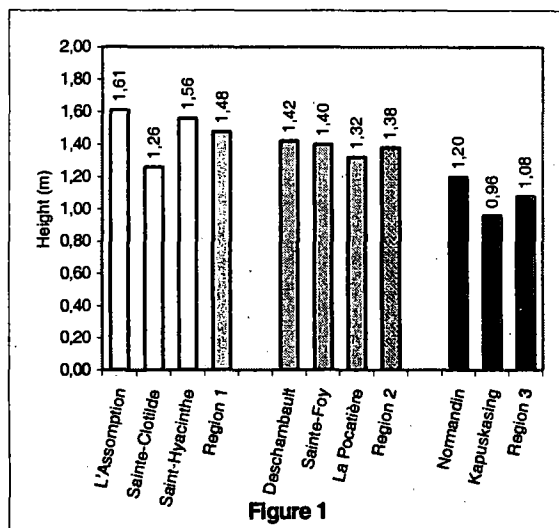


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

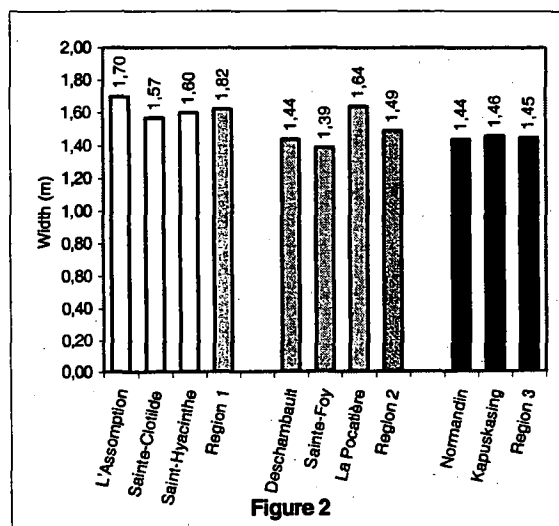


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

The height values were quite homogeneous within each of the regions. Sainte-Clotilde and Kapuskasing caused a slight decrease in the mean regional value.

Effect of pruning

No pruning was done at Sainte-Clotilde, La Pocatière or Kapuskasing. Light pruning was carried out at all the other sites.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Unlike in previous years, it took three growing seasons for the shrubs to reach a height of 0.51-1.00 m at almost every site, since they did not recover as well after transplanting due to propagation conditions.

At Kapuskasing, the shrubs reached this height after five growing seasons.

HARDINESS EVALUATION

As in previous trials, little or no mortality occurred in zone 2 and survival is probably assured in zone 1.

The plants can be used and achieve full ornamental potential in zone 2, however, frost damage to the branch tips may occur occasionally.

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Cornus alba* 'Argenteo-marginata' (Control 1992) from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	5	6	7	8	10	11	
1	2	3	4	5	6	7	8	10	11		
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	98							2			2
Saint-Hyacinthe	100										0
REGION 2											
Deschambault	98								2		2
Sainte-Foy	91	7		1				1			9
La Pocatière	98							2			2
REGION 3											
Normandin	77	20							3		23
Kapuskasing	99							1			1

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Cornus alba* 'Argenteo-marginata' (Control 1992) plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	25	0	0	0	100	18	0	0	0	81	5	0	0	0
051-100	0	75	50	25	0	0	82	75	33	25	19	57	25	0	0
101-150	0	0	50	75	33	0	0	25	67	58	0	38	75	100	42
151-200	0	0	0	0	67	0	0	0	0	17	0	0	0	0	58
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	5	0	0	0	100	10	0	0	0	100	0	0	0	0
051-100	0	90	58	33	0	0	90	55	0	0	0	100	10	0	0
101-150	0	5	42	67	83	0	0	45	100	82	0	0	90	100	100
151-200	0	0	0	0	17	0	0	0	0	18	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	88	0	0	0	0	100	74	0	0	0					
051-100	12	62	42	0	0	0	26	100	91	75					
101-150	0	38	58	100	100	0	0	0	9	25					
151-200	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Cornus alba* 'Argenteo-marginata' (Control 1992) plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	10	0	0	0	100	12	0	0	0	100	5	0	0	0
051-100	0	90	25	8	0	0	88	42	8	0	0	24	0	0	0
101-150	0	0	67	92	17	0	0	58	83	50	0	66	83	58	42
151-200	0	0	8	0	75	0	0	0	9	50	0	5	17	42	58
201-250	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	10	0	0	0	100	5	0	0	0	100	9	0	0	0
051-100	0	70	25	8	0	0	74	18	0	0	0	91	10	10	0
101-150	0	20	75	84	83	0	21	82	73	73	0	0	90	50	30
151-200	0	0	0	8	17	0	0	0	27	27	0	0	0	40	70
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	0	0	0	0	100	58	0	0	0					
051-100	0	63	33	0	0	0	42	58	8	0					
101-150	0	37	67	83	67	0	0	42	92	75					
151-200	0	0	0	17	33	0	0	0	0	25					
201-250	-	-	-	-	-	-	-	-	-	-					

COTONEASTER ACUTIFOLIUS

TURCZ.

Family:	Rosaceae
English name:	Peking Cotoneaster
French name:	Cotonéastre de Pékin
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This bushy shrub of erect habit can grow to 2 m high and over 1 m wide. Branches are long and pubescent, spreading with age.

The small brownish buds are pointed and sharp, almost thorny. The small, entire, alternate leaves are oval to lanceolate and acute at the apex. The leaves, 2-5 cm long, are dark green and slightly shiny above and pale and downy on the underside. They turn a beautiful shade of orange-red in fall.

The small pinkish white flowers, occurring in small corymbs of three or more, appear in early May, measuring 10-12 mm in diameter.

The fruits are small ellipsoid drupes, measuring 8 mm across and containing two seeds. Initially red, they turn black in September, and do not persist into winter.

The shrub grows rapidly and has fibrous roots.

ORIGIN AND DISTRIBUTION

This species, known since 1883, is native to northern China and Mongolia.

USE

Ornamental: This species can be used for hedges or large mass plantings.

DISEASES AND INSECTS

The species is very susceptible to fireblight (*Erwinia amylovora*) when conditions are propitious for the disease.

Cedar rust diseases (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases that begin their life cycle on *Juniperus* and require an intermediate host. The second phase occurs on several plants in the Rosaceae family, including cotoneasters. Septoria leaf spot (*Septoria* sp.) can also cause damage when conditions are ripe for its development.

Scale insects attack cotoneasters, with oystershell scale (*Lepidosaphes ulmi*) causing the most damage. The roundheaded apple tree borer (*Saperda candida*), a boring insect, also attacks the species. Damage to entire stems was seen at La Pocatière.

In the test, the dieback of parts of stems was observed on seedlings at all sites in regions 1 and 2. Several seedlings that were severely affected died.

REQUIREMENTS

This species requires full sun but is less demanding about the soil, thriving in poor, wet or dry soils.

It is easily transplanted bareroot and tolerates pruning well.

PROPAGATION

Seeds: Due to the hardness of the seed coat, seeds must undergo a period of warm, then cold, stratification to ensure a high success rate. Another equally suitable method is to treat the seeds with a concentrated solution of sulphuric acid and then stratify them at cold temperatures for three to four months.

Cuttings: Semi-woody cuttings can be taken from late June to late July from deciduous species of cotoneaster, including *C. acutifolius*. Rooting occurs within four to six weeks.

Grafting: The species can be used as a rootstock.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: Seeds were harvested in October 1988 from parent plants 2 m tall. They were immediately sown in flats and placed outside. Germination the following spring was very uneven. On June 22, 1990, 240 seedlings roughly 15 cm high were potted up and placed in beds where they spent the rest of the summer, fall and winter, protected by glass cold frames. The winter survival rate was 100 %. On May 1, 1991, the seedlings were wrapped and placed in the cold store at 4 °C to await shipping.

Inclusion in testing network: Young seedlings 15-cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, four seedlings died the first winter. The second winter, one plant had frost damage to the branch tips. No damage was observed subsequently.

At Sainte-Clotilde, a single plant suffered frost damage to the branch tips during the last winter, but no other damage occurred.

At Saint-Hyacinthe, 25 % of plants died the first winter and 33 % suffered frost damage to the branch tips the third winter. No other damage occurred.

Region 2

The only damage that occurred at Sainte-Foy was in the third winter: two plants suffered frost damage to the branch tips, two plants suffered frost damage to the previous year's shoots and five shrubs suffered frost damage to the old wood. No other damage occurred.

At Deschambault, the only frost damage that occurred was in the third winter: half the seedlings suffered damage to the one-year-old shoots and two seedlings suffered frost damage to the branch tips. The last winter, half the seedlings were damaged by rodents.

No damage occurred at La Pocatière.

Region 3

At Normandin, 33 % and 67 % of plants suffered mechanical breakage during the second and fourth winters. Trunk splitting occurred in over 80 % of shrubs the third winter. No other damage occurred.

At Kapuskasing, 20 seedlings died the first winter and the remaining one died the second winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years of testing at each site in the three regions.

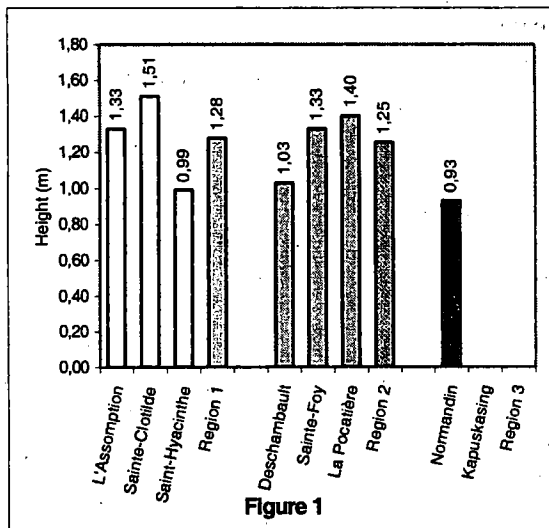


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

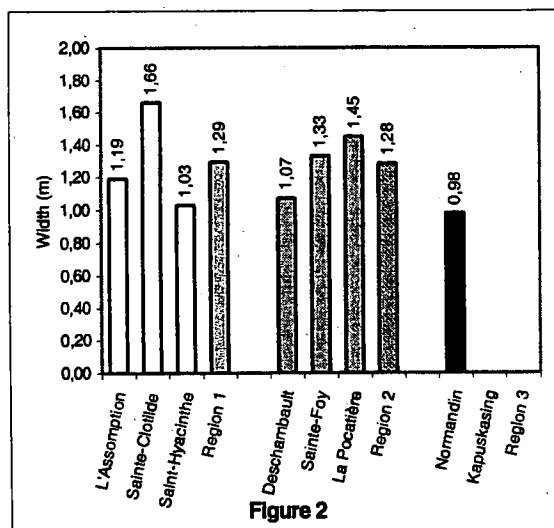


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

The shrubs reached their maximum height the third year at Normandin and Saint-Hyacinthe. Height growth occurred steadily at the other sites. By the end of the tests, at Sainte-Clotilde, Sainte-Foy and La Pocatière, the shrubs were wider than they were tall while at Saint-Hyacinthe, Deschambault and Normandin, they were almost as wide as they were tall.

Effect of pruning

At L'Assomption, Saint-Hyacinthe and Normandin, the shrubs were cut back by one third every spring. Light pruning was done at Sainte-Foy and Deschambault, while no pruning was done at Sainte-Clotilde and La Pocatière.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

Growth is rapid and all the seedlings at Sainte-Clotilde, Sainte-Foy, La Pocatière and Normandin were over 0.51 m tall after two growing seasons. An additional year was required at the three other sites to reach a comparable height.

This cultivar can be produced in all hardiness zones covered in the test except for 2a.

HARDINESS EVALUATION

According to the literature, this species' hardiness extends to zone 2. The test results indicate the plant will survive as far as zone 2b (in Kapuskasing, in zone 2a, all the seedlings died during the first two winters).

The use of this plant can be recommended in all hardiness zones from 2b to 5.

The species achieved full ornamental potential at Sainte-Clotilde and La Pocatière, where height and width were comparable.

BIBLIOGRAPHIC REFERENCES

2, 7, 8, 9, 21, 26, 31, 35

WRITTEN BY

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Chantal Gauthier, Horticulturist

Michel Auger, Tech.

Table 1. Frequency of winter damage observed on *Cotoneaster acutifolius* Turcz. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	95	1					4				5
Sainte-Clotilde	98	2									2
Saint-Hyacinthe	90	7					3				10
REGION 2											
Deschambault	77	3	10							10	23
Sainte-Foy	85	3	4	8							15
La Pocatière	100										0
REGION 3											
Normandin	63							17	20		37
Kapuskasing	5						95				95

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 6 and 7 occurred for this species.

Table 2. Breakdown of *Cotoneaster acutifolius* Turcz. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	95	24	0	0	0	100	43	0	0	0	-	0	0	0	0
051-100	5	76	91	64	0	0	57	17	0	0	-	94	36	83	18
101-150	0	0	9	36	64	0	0	83	92	58	-	6	64	17	82
151-200	0	0	0	0	36	0	0	0	8	42	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	52	0	0	0	100	0	0	0	0	100	5	0	0	0
051-100	0	48	100	100	50	0	100	33	8	17	0	95	75	0	0
101-150	0	0	0	0	50	0	0	67	92	58	0	0	25	100	92
151-200	-	-	-	-	-	0	0	0	0	25	0	0	0	0	8
REGION 3															
Height (cm)	Normandin					Kapuskasing**									
	91	92	93	94	95	91	92	93	94	95					
001-050	100	0	0	0	0	100	100	-	-	-					
051-100	0	100	50	100	58	-	-	-	-	-					
101-150	0	0	50	0	42	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

**All plants were died after the second winter.

Table 3. Breakdown of *Cotoneaster acutifolius* Turcz. plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	65	0	0	0	100	71	0	0	0	-	6	0	0	0
051-100	0	35	64	73	0	0	29	42	0	0	-	88	55	33	9
101-150	0	0	36	27	100	0	0	58	58	25	-	6	45	67	91
151-200	-	-	-	-	-	0	0	0	42	75	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	19	0	0	0	95	0	33	0	0	100	10	0	0	0
051-100	0	81	58	42	33	5	100	22	0	8	0	90	25	0	0
101-150	0	0	42	58	67	0	0	45	100	84	0	0	75	75	67
151-200	-	-	-	-	-	0	0	0	0	8	0	0	0	25	33
REGION 3															
Width (cm)	Normandin					Kapuskasing**									
	91	92	93	94	95	91	92	93	94	95					
001-050	95	0	0	0	8	100	100	-	-	-					
051-100	5	100	0	17	42	-	-	-	-	-					
101-150	0	0	100	83	50	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*Datas were collected since 1992.

**All plants were died after the second winter.

COTONEASTER HORIZONTALIS

DECNE.

Family:	Rosaceae
English name:	Rock Cotoneaster
French name:	Cotonéastre des rochers
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This spreading plant rarely grows taller than 0.5 m tall, but easily reaches over 2.0 m in width.

The horizontal branches have numerous opposite downy twigs.

The small rounded leaves, 6-12 mm long, grow in tight rows and are oval in shape, with an acute apex. They are shiny dark green on the upper surface and glaucous on the underside, and glabrous. In fall, the foliage is orangish to purplish. The leaves are retained until very late in the season.

The small pink flowers, occurring singly or in pairs, appear in late May or early June.

The many globular drupes, 6 mm across, contain two or three seeds. The fruits remain on the shrub until late in the fall and are an attractive bright red.

The roots tend to be scarce, scattered and shallow. Stems touching the soil layer easily.

ORIGIN AND DISTRIBUTION

This species is native to Western China (Szechwan Province) and was identified in 1866 by Père David. It was available on the market as early as 1885.

USE

Ornamental: This species, which is useful in rock gardens or large mass plantings, has a number of ornamental characteristics including its prostrate habit, colour of foliage and fruit and the fact that the fruits remain on the shrub until late autumn.

Value to birds: The small fruits attract birds in fall and winter.

DISEASES AND INSECTS

Cedar rust diseases (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases that begin their life cycle on *Juniperus* and require an intermediate host. Several plants in the Rosaceae family, including cotoneasters, are particularly susceptible. Septoria leaf spot (*Septoria* sp.) can also cause damage when conditions are favourable for the disease.

The species is very susceptible to fireblight (*Erwinia amylovora*) when conditions are propitious to the disease.

Scale insects also attack cotoneasters, with oystershell scale (*Lepidosaphes ulmi*) causing the most damage. The roundheaded apple tree borer (*Saperda candida*), a boring insect, also attacks the species.

In the tests, damage was observed on seedlings at all sites in regions 1 and 2, resulting in dieback; several seedlings that were severely affected died.

REQUIREMENTS

Optimum conditions for the species comprise a sunny site, with well-drained, fertile, loamy soil. Growth is slow.

Pruning, which should be done in early spring, is often limited to removing any dead wood and bare branches.

In general, this shrub requires extensive winter protection in the form of an abundant snow cover.

PROPAGATION

Seeds: Fruits can be harvested shortly before they ripen and the pulp removed to obtain the seeds. The seeds can then be sown in beds immediately, allowing natural stratification (protection against rodents is required, however). Dried, ripe seeds with hardened seed coats must be scarified in a bath of concentrated sulphuric acid for 90 minutes. It is also recommended that seeds undergo warm stratification for three months and then cold stratification for four months before sowing. Without treatment, dried seeds will take at least two years to germinate.

Layering: Layering techniques with or without an incision work well with this prostrate species.

Cuttings: Semi-woody cuttings taken in early July and treated with auxin solutions (5,000 to 10,000 ppm) give good results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Purchase

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: In the summer of 1986, seeds were planted in trays placed in an outdoor cold frame. On July 11, 1988, 240 seedlings were potted up in Fertil Pots® and placed in a bed to overwinter, protected by a glass cold frame. The winter survival rate was 100 %. The seedlings were kept in the bed until shipping in May 1991.

Inclusion in testing network: Young seedlings 15-cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At Sainte-Clotilde, 23 % of the seedlings died the first winter. In all the winters, all the surviving plants had frost damage to their aerial portions down to the snow cover.

At L'Assomption, 27 % of seedlings died the first winter. In the third winter, 63 % of the plants had frost damage to the branch tips. In the first two and last two winters, all the surviving plants had frost damage to their aerial portions down to the snow cover.

At Saint-Hyacinthe, damage to branch tips occurred in 8 %, 50 %, 67 %, 33 % and 100 % of the shrubs during the five winters. Over half the plants died the first winter and 25 % the following winter, leaving only two seedlings to be evaluated. In the first winter, almost all the surviving plants suffered foliage browning. The second winter, 25 % of plants had frost damage to the one-year-old shoots. The third winter, 33 % of shrubs had frost damage to their aerial portions down to the snow cover.

Region 2

At Sainte-Foy, frost damage was observed in the aerial portions of the seedlings down to the snow cover in 100 %, 69 % and 100 % of seedlings during the first three winters. The branch tips were affected in 31 % and 92 % of seedlings the third and fourth winters. No damage occurred the last winter.

At Deschambault, frost damage to the branch tips occurred in 8 %, 42 %, 33 %, 60 % and 80 % of seedlings during the five winters and 17 % of seedlings died the third winter. Frost damage to the one-year-old shoots was observed in 42 % and 17 % of seedlings during the second and third

winters. Frost damage to the aerial portion of the shrub extending right to the ground occurred in 92 % and 8 % of seedlings during the first two winters. Rodents damaged a seedling the last winter.

At La Pocatière, frost damage to the aerial portions down to the snow cover occurred in 100 %, 100 %, 83 %, 58 % and 100 % of the seedlings in the five winters. One shrub had frost damage to the one-year-old shoots during the third winter and 25 % of shrubs suffered frost damage to the branch tips in the fourth winter.

Region 3

At Normandin, 15 %, 9 %, 22 % and 43 % of plants died during the first four winters. During the first winter, 69 % of seedlings had frost damage to the one-year-old shoots and 15 % had damage to the branch tips. The latter injury was found in 82 % of the plants the following winter. After the fourth winter, 78 % of the shrubs suffered foliage browning to the persistent leaves. The four surviving shrubs had no damage during the last winter.

At Kapuskasing, 83 % of the seedlings died the first winter and an additional plant died the third winter, leaving only one plant alive at the end of the tests. All surviving plants suffered frost damage to the one-year-old shoots or the entire aerial portion.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years of testing at each site in the three regions.

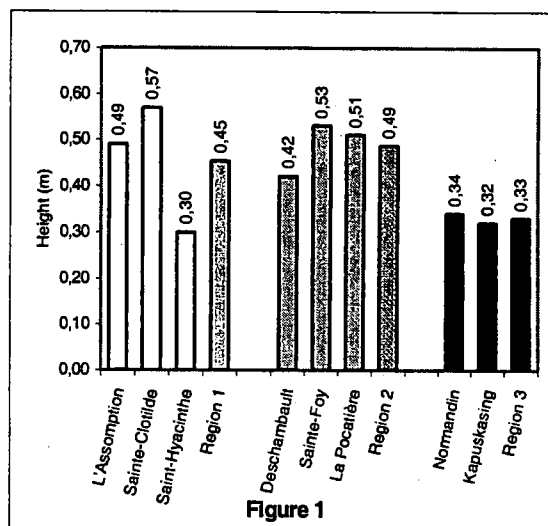


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

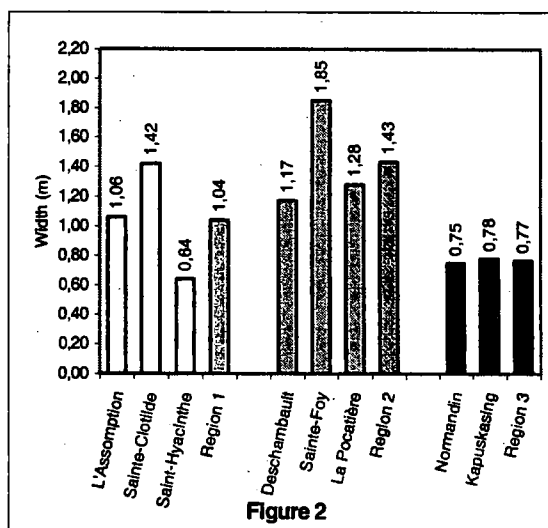


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Height and width growth was particularly homogeneous in region 3. At Sainte-Foy, all shrubs were wider than they were tall by the second year of testing.

Effect of pruning

No pruning was done at Sainte-Clotilde, while pruning proportionate to the damage suffered was done at the other sites.

Flowering

Flowering occurred only rarely at sites in regions 1 and 3, in only one out of five years and on only a few seedlings. Flowering did not occur in Kapuskasing. At Sainte-Foy and La Pocatière, the plants only flowered the last two or three years of the tests.

In general, flowering lasted 11 to 19 days at all sites. In region 1, the first flowers were observed on June 3 or thereabouts on the south shore of the St. Lawrence and around June 13 on the north shore. At the three sites in region 2, the first flowers invariably appeared between June 15 and 23, which at Deschambault and Sainte-Foy, was 2 or 3 days later than at L'Assomption; the difference was one week for La Pocatière.

At Normandin, flowering lasted for around 23 days, from June 22 to July 20.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

Adequate winter protection is essential for production of this species in regions 1 and 2. When field-grown, the species is subject to extensive damage that reduces the species' ornamental value in spring and entails severe pruning.

HARDINESS EVALUATION

According to the literature consulted, this species' hardiness extends to zone 5 or 6. The test results show that survival is uncertain in zone 2, and in other zones when the snow cover is insufficient. The latter condition is common in the Montreal region. Almost all plants survived

and grew well in zone 4, due to the extensive snow cover during the entire winter.

The use of this plant can be recommended as far north as zone 4, given adequate snow cover.

Full ornamental potential was not achieved in the zones tested.

BIBLIOGRAPHIC REFERENCES

2, 4, 7, 8, 21, 28, 33, 39, 67, 75

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Table 1. Frequency of winter damage observed on *Cotoneaster horizontalis* Decne. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
	1	2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	8	13				74		5					92
Sainte-Clotilde	2					93		5					98
Saint-Hyacinthe	13	52		5		6		18				6	87
REGION 2													
Deschambault	18	45		12			20	3			2		82
Sainte-Foy	22	24				54							78
La Pocatière	3	5		2		90							97
REGION 3													
Normandin	33	19		14				18				16	67
Kapuskasing	0			54			20	26					100

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 9 and 10 occurred for this species.

Table 2. Breakdown of *Cotoneaster horizontalis* Decne. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	18	13	0	0	0	23	10	0	0	0	-	0	0	0	0
021-040	46	87	88	25	13	7	70	11	22	0	-	100	100	100	100
041-060	36	0	12	75	75	70	20	78	45	100	-	-	-	-	-
061-080	0	0	0	0	12	0	0	11	33	0	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	8	50	8	0	0	61	23	0	0	0	0	23	0	0	0
021-040	67	50	92	90	40	31	77	25	17	25	23	70	42	33	0
041-060	25	0	0	10	60	8	0	75	58	42	46	7	58	34	100
061-080	-	-	-	-	-	0	0	0	25	33	31	0	0	33	0
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	23	64	22	29	25	0	100	50	0	0					
021-040	69	36	67	57	50	92	0	50	100	100					
041-060	8	0	11	14	25	8	0	0	0	0					
061-080	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Cotoneaster horizontalis* Decne. plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	64	63	0	0	0	100	40	0	0	0	-	100	0	0	33
051-100	36	37	100	87	75	0	60	11	11	0	-	0	100	100	67
101-150	0	0	0	13	25	0	0	89	78	89	-	0	0	0	0
151-200	0	0	0	0	0	0	0	0	11	11	-	0	0	0	0
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	50	50	8	0	0	77	0	0	0	0	69	8	0	0	0
051-100	50	50	92	100	20	23	92	25	8	0	31	92	17	17	0
101-150	0	0	0	0	80	0	8	75	17	17	0	0	83	67	100
151-200	-	-	-	-	-	0	0	0	75	50	0	0	0	16	0
201-250	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	61	27	33	43	25	92	100	100	0	0					
051-100	39	73	67	57	75	8	0	0	100	100					
101-150	-	-	-	-	-	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

CRATAEGUS BASILICA

Family:	Rosaceae
English name:	Magnificent Thorn
French name:	Aubépine magnifique
Category:	Deciduous plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

The description for this small indigenous tree is similar to that for *Crataegus coccinea*, except for the height attained at maturity (6 m) and the characteristics of the fruits and thorns.

The fruits look like small, bright red apples and are 10 to 14 mm in diameter.

The needles are long and flexible.

ORIGIN AND DISTRIBUTION

This indigenous species has been known since 1730. It occurs in southern Ontario and Quebec, as well as in Maine, Iowa and Northern Carolina. It grows mainly along water bodies and in clearings.

USES

Ornamental: This species with its beautiful flowers and persistent fruits is popular in small city gardens. When the trees are in bloom, mass plantings in large areas have an outstanding effect.

Cooking: The small apples make an excellent jelly.

Wildlife: The thin flesh of the fruits is a favourite food source for birds and mammals, which play a leading role in seed dispersal.

REQUIREMENTS

Crataegus prefers alkaline soils and a sunny exposure. The species can tolerate atmospheric pollution well. Pruning should be carried out after flowering has ended.

DISEASES AND INSECTS

Cedar rust diseases (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases that begin their life cycle on *Juniperus* and require an intermediate host. Several species in the family Rosaceae, including hawthorns, are particularly susceptible. Other fungal diseases that may affect the species include powdery mildew (*Podosphaera* sp.) and grey mould rot (*Botrytis* sp.).

This hawthorn is very susceptible to fireblight (*Erwinia amylovora*) when conditions are favourable for this bacterium's development.

The roundheaded apple tree borer (*Saperda candida*) is a boring insect that typically attacks hawthorns. Other pests include the eastern tent caterpillar (*Malacosoma americanum*) and the Japanese beetle (*Popillia japonica*), which can cause temporary and permanent damage (mortality of portions of branches or the entire tree).

Seeds: This is the best propagation method for all species if seeds are available. Fruits should be harvested in early fall and the manually de-pulped seeds should be stratified in sand or peat. Seed germination occurs during the second year.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of mother plant: Montreal Botanical Garden Arboretum, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were collected on September 27, 1989 and allowed to rot; the seeds were extracted manually and then stored. Stratification began on November 3, when the seeds were placed in wet peat moss and kept at 25 °C until January 21, 1990, and then at 5 °C until May 15. They were sown 10 mm deep in a Promix® and sand medium (1:2; v:v) and shaded with a cloth (63 %). The seeds germinated 152 days later. On May 23,

1991, the seedlings were transplanted to the nursery and grown until the fall, after which they were dug, puddled and heeled in. In mid-April 1992, they were wrapped and stored in the cellar to await shipping.

Inclusion in testing network: Young seedlings 27 cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 21 % of seedlings exhibited frost damage to the branch tips but only during the first winter. No other damage was recorded.

The seedlings at Sainte-Clotilde and Saint-Hyacinthe did not suffer any damage.

Region 2

The first three winters, 25 %, 20 % and 33 % of the plants at Sainte-Foy suffered frost damage to the branch tips. In addition, 17 % and 75 % of the plants suffered mechanical breakage the third and fifth winters.

At Deschambault, 10 %, 25 % and 8 % of the plants had frost damage to the branch tips during the first two winters and the fourth one. In addition, 25 % of the trees suffered mechanical breakage the last winter.

At La Pocatière, frost injury to the branch tips was the only damage observed (half of plants) the first two winters.

Region 3

At Normandin, one tree died during the fourth winter. In the second and fourth winters, 45 % and 75 % of the plants suffered frost damage to the branch tips. In addition, 33 % and 45 % of the plants were damaged by the weight of the snow the third and fifth winters.

At Kapuskasing, three plants died during the second and third winters. The one-year-old shoots had frost damage every year in 53 %, 58 %, 10 %, 33 % and 44 % of plants. The branch tips were damaged in 16 %, 10 % and 22 % of the trees during the first two winters and the last winter. In addition, 16 % and 44 % of the seedlings froze right down to the ground level the first and fourth winters. Mechanical breakage occurred in 22 % and 33 % of the trees the last two winters.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the plants after five years at each site in the three regions.

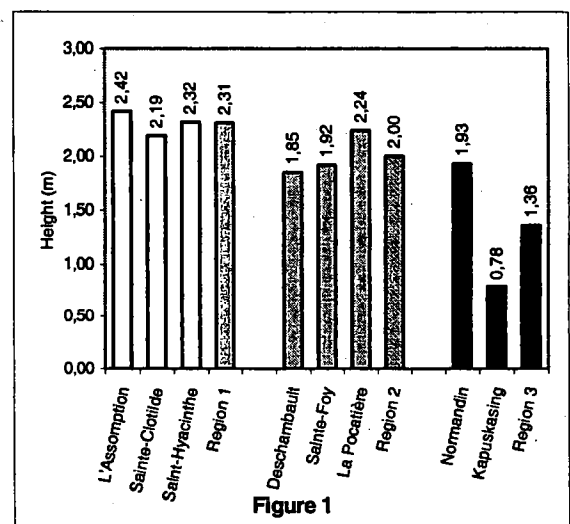


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

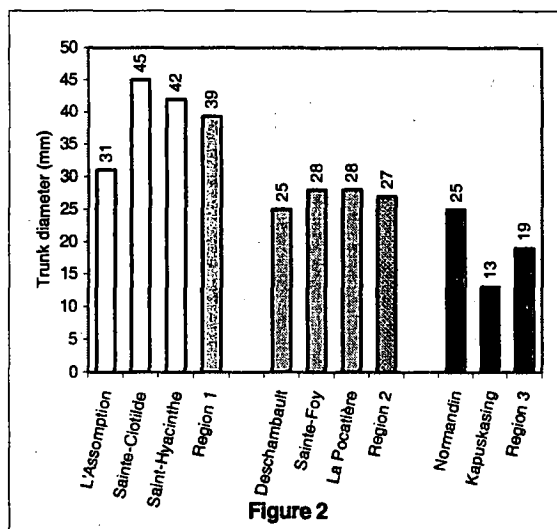


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

The heights attained were fairly similar within regions 1 and 2. The plants at Kapuskasing showed the slowest growth, owing to repeated sessions of severe pruning.

The trunk diameter of the trees was especially homogeneous within region 2.

Effect of pruning

As a result of frost damage, the trees at the region 3 sites had to be pruned severely; more than half of the plant mass was sometimes removed.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

After three growing seasons, 91 %, 100 %, 83 % and 83 % of the trees at L'Assomption, Sainte-Clotilde, Saint-Hyacinthe and La Pocatière had reached a height of 1-2 m. It took an extra year to obtain similar height values at

Deschambault, Sainte-Foy and Normandin. The species' growth was slower at Normandin as compared with the growth of *Crataegus coccinea*.

With regard to trunk diameter, this species' growth was slower than that of *C. coccinea*, and 64 %, 82 % and 82 % of the trees at L'Assomption, Sainte-Clotilde and Saint-Hyacinthe had reached a diameter greater than 21 mm after three growing seasons. It took one to two extra years to obtain trees with a comparable girth at all the other sites, except Kapuskasing.

This species can be produced at region 1 and 2 sites, but trees with a greater height and diameter were obtained at some sites in region 1. Region 3, especially zone 2a, is not recommended for production.

HARDINESS EVALUATION

The hardiness of this species is not known; however, several hawthorns are classified as hardy to Canadian zones 4 and 5. As with *Crataegus coccinea*, the test results show that the species can survive as far as zone 2a, provide the seedlings are adequately protected by snow cover.

Whereas this tree can be used as far as zone 2b without severe damage, in zone 2a, it must be considered a shrub, since the stems can freeze right down to the snow cover every winter. Breakages caused by the weight of the snow are a frequent occurrence with branches attached to the trunk beneath the snow cover.

Full ornamental potential was achieved at the sites in zone 5, since the species did not exhibit any damage when grown on the south shore of the St. Lawrence.

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3, 7

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Table 1. Frequency of winter damage observed on *Crataegus basilica* from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	96	4									4
Sainte-Clotilde	100										0
Saint-Hyacinthe	100										0
REGION 2											
Deschambault	86	9							5		14
Sainte-Foy	76	12							12		24
La Pocatière	80	20									20
REGION 3											
Normandin	59	24					2		15		41
Kapuskasing	23	10	40				12	4	11		77

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 6, 9 and 11 occurred for this species.

Table 2. Breakdown of *Crataegus basilica* plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	84	10	0	0	0	100	6	0	0	0	67	5	0	0	0
051-100	16	74	9	9	9	0	69	0	0	0	33	76	17	0	0
101-150	0	16	36	9	0	0	25	82	0	18	0	19	50	8	0
151-200	0	0	55	36	9	0	0	18	91	9	0	0	33	42	17
201-250	0	0	0	46	27	0	0	0	9	46	0	0	0	50	58
251-300	0	0	0	0	55	0	0	0	0	27	0	0	0	0	25
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	90	20	0	0	0	80	15	0	0	0	72	10	0	0	0
051-100	10	75	50	0	0	20	75	33	9	8	28	61	17	0	0
101-150	0	5	50	67	8	0	10	59	33	8	0	29	50	0	0
151-200	0	0	0	33	50	0	0	8	58	25	0	0	33	58	17
201-250	0	0	0	0	42	0	0	0	0	50	0	0	0	42	58
251-300	-	-	-	-	-	0	0	0	0	9	0	0	0	0	25
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	20	0	0	0	0	89	42	30	0	0					
051-100	70	60	50	8	0	11	58	70	22	100					
101-150	10	40	50	25	18	0	0	0	67	0					
151-200	0	0	0	50	46	0	0	0	11	0					
201-250	0	0	0	17	36	0	0	0	0	0					
251-300	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Crataegus basilica* plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	84	36	0	0	100	38	18	0	0	100	81	17	0	0
021-040	0	16	64	100	100	0	62	82	65	46	0	19	83	83	42
041-060	-	-	-	-	-	0	0	0	35	54	0	0	0	17	58
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	100	50	17	100	85	67	8	8	100	100	42	17	8
021-040	0	0	0	50	83	0	15	33	92	92	0	0	58	83	92
041-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	100	100	75	18	100	100	100	100	89					
021-040	0	0	0	25	82	0	0	0	0	11					
041-060	-	-	-	-	-	-	-	-	-	-					

CRATAEGUS COCCINEA L.

Family:	Rosaceae
English name:	Scarlet Thorn
French name:	Aubépine écarlate
Category:	Deciduous plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

This small native tree, of variable habit, can reach a height of 3 m.

The crooked trunk is covered with bark evenly divided into firm strips that become loose at both ends.

The short, lustrous twigs range in colour from pale grey to orange brown. They are either long and straight, or zigzag. The terminal flowers are borne on dwarf shoots.

The terminal bud is broad, rounded and smooth, with 2 to 5 pairs of scales. It is a shiny reddish-brown. The lateral buds are slightly smaller, often occurring in twos or threes, one developing into a thorn and the other into a new shoot bearing leaves or flowers. The leaf scars are narrow and slightly elevated, with three vein scars. The stout, curved thorns range to 6 cm in length.

The dentate leaves are elliptic to oval, measuring 6-9 cm in length. The leaves are glabrous, shiny and dark green above, and sometimes slightly pubescent below.

The white flowers are borne on long pedicels and grouped in wide corymbs, each containing 3 to 7 flowers. Each flower consists of five white petals, 5-25 stamens and 1-5 carpels. The anthers are bright yellow. The flowers are showy like those of *Malus*, but bloom a little later, appearing the same time as the leaves.

The globose fruits become scarlet red when ripe and often remain on the tree late into fall. Each fruit has 3 to 4 seeds.

ORIGIN AND DISTRIBUTION

This native species has been known since 1737. It ranges from southern Ontario and Quebec and Maine west to Iowa and south to North Carolina. It is particularly common along streams and forest openings.

USE

Ornamental: Although care must be taken with the thorns, this species can be used as a protective hedge. It can also be used as a specimen plant in small gardens or in mass plantings in large areas. Flowering is spectacular in spring.

Wildlife: The thin flesh of the fruits is much appreciated by birds and mammals. Mammals are particularly efficient seed dispersers.

REQUIREMENTS

Crataegus species prefer calcareous soils and sunny exposures. They are highly resistant to air pollution. Pruning must be done after flowering ends.

DISEASES AND INSECTS

Cedar rust diseases (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases that begin their life cycle on *Juniperus* and require an intermediate host to complete it. Several plants in the Rosaceae family, including hawthorns, are particularly susceptible. Other fungal diseases that may occur in the species include powdery mildew (*Podosphaera* sp.) and grey mould rot (*Botrytis* sp.).

The species is very susceptible to fireblight (*Erwinia amylovora*), when conditions are favourable for the disease.

The roundheaded apple tree borer (*Saperda candida*) is a boring insect that also attacks the species. Other pests include the eastern tent caterpillar (*Malacosoma americanum*) and the Japanese beetle (*Popillia japonica*), which can cause temporary or permanent damage (death of portions of branches or the entire tree).

PROPAGATION

Seeds: When seeds are available, this is the best propagation method for the genus. Fruits should be harvested in early fall and the pulp removed manually. The seeds are then stratified in sand or peat moss. The seeds germinate the second year.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were collected on September 27, 1989. After the pericarp was allowed to rot, the seeds were extracted manually, then put in storage. Stratification began on November 3, when the seeds were placed in wet peat moss at 25 °C. On January 21, the temperature was lowered to 5 °C. On May 15, the seeds were sown 10 mm deep in a Promix® and sand (1:2; v:v) medium and shaded with a cloth (63 %). The seeds germinated in May 1991 and the seedlings were grown in a propagation bed until fall, when they were dug up, puddled and heeled in for the winter. In mid-April 1992, they were wrapped and placed in the cellar to await shipping.

Inclusion in testing network: Young seedlings 5-cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died the first winter. The first two winters, 20 % and 5 % of plants suffered frost damage to the branch tips.

At Sainte-Clotilde, 15 % and 11 % of the seedlings died during the first two winters. One seedling suffered frost damage to the branch tips during the first winter.

At Saint-Hyacinthe, one seedling died the first winter and three other plants suffered frost damage to the branch tips.

Region 2

During the first three winters at Sainte-Foy, 37 %, 21 % and 9 % of plants suffered frost damage to the branch tips. Mechanical breakage occurred in one plant during the fourth winter and in almost all trees the last winter.

At Deschambault, frost damage to the branch tips was observed in 6 %, 56 % and 8 % of plants during the first two winters and the fourth winter.

At La Pocatière, three seedlings died the first winter and one seedling had frost damage to the one-year-old shoots. In the first three winters, 9 %, 28 % and 17 % of plants suffered frost damage to the branch tips.

Region 3

At Normandin, 100 % and 62 % of seedlings suffered frost damage to the branch tips during the first two winters. In addition, 33 % of the plants froze down to the snow cover during the second winter. Mechanical breakage occurred in 8 % and 50 % of trees during the third and fifth winters.

At Kapuskasing, 22 % and 21 % of seedlings died during the first two winters. Frost damage to the one-year-old shoots was observed in 17 %, 43 %, 30 %, 90 % and 70 % of plants during the five winters. During the first three winters, frost damage to the branch tips occurred in 11 %, 21 % and 20 % of plants. Mechanical breakage occurred in 11 %, 10 % and 20 % of plants during the first winter and the last two winters.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the trees after five years of testing at each site in the three regions.

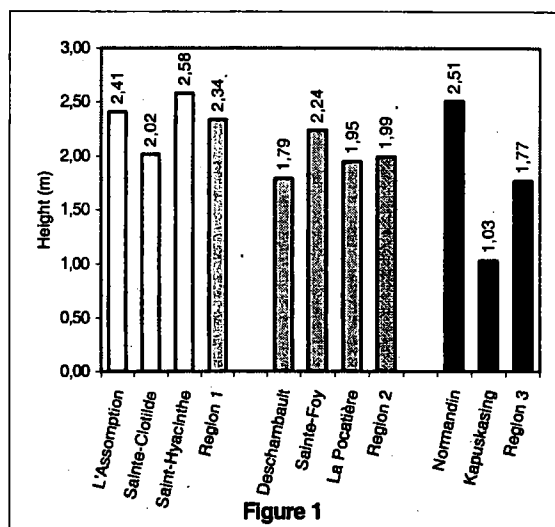


Figure 1. Mean height of trees at trial's end at each of the eight sites and the three regions

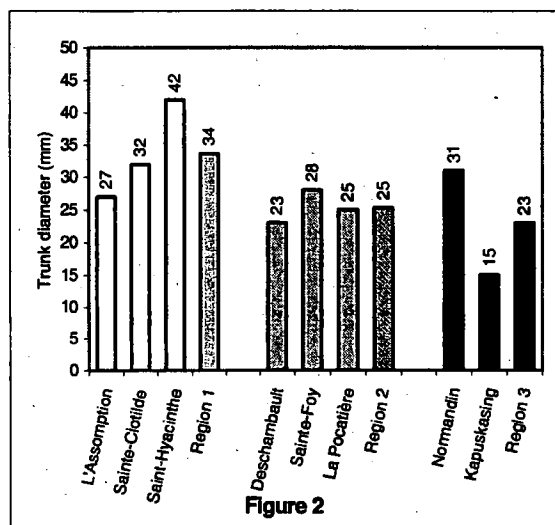


Figure 2. Mean trunk diameter width of trees at trial's end at each of the eight sites and the three regions

Trunk diameter at the end of the tests was particularly homogenous at all the sites.

Effect of pruning

Every other year, the plants had to be cut back by between 30 % and 50 % of their height. The last spring in Kapuskasing, the trees had to be cut back severely, resulting in a significant reduction in their final height.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and trunk diameter are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and trunk diameter.

After three growing seasons, 100 %, 83 % and 92 % of the plants at Saint-Hyacinthe, La Pocatière and Normandin had reached between 1 and 2 m in height. At the other sites, an additional year was required to reach a similar height.

In terms of diameter, only the seedlings at Saint-Hyacinthe had diameters of over 21 mm after three growing seasons. At the other sites, one or two additional seasons were required to attain a comparable diameter, except at Kapuskasing.

The species can be produced in regions 1 and 2; trees of superior height and diameter were obtained at Saint-Hyacinthe after three years. Production is not recommended in region 3, particularly in zone 2a.

HARDINESS EVALUATION

According to the literature consulted, this species' hardiness extends to USDA zone 3. The test results show that the species can survive up to zone 2a, when snow cover provides adequate protection.

The species can be used as far as zone 2b without severe damage occurring. In zone 2a, it grows more like a shrub, since the branches can freeze down to the snow cover.

Full ornamental potential of the young trees was not achieved in the tests. However, wild trees suffer little or no damage in southern Quebec, which falls within its natural range.

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3, 4, 41

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Table 1. Frequency of winter damage observed on *Crataegus coccinea* L. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	92	7					1				8
Sainte-Clotilde	94	1					5				6
Saint-Hyacinthe	86	3					1			10	14
REGION 2											
Deschambault	86	14									14
Sainte-Foy	68	13							19		32
La Pocatière	79	11	1				3		6		21
REGION 3											
Normandin	50	32			6				12		50
Kapuskasing	23	10	50				9		8		77

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 7 and 9 occurred for this species.

Table 2. Breakdown of *Crataegus coccinea* L. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	100	33	0	0	100	95	42	8	8	100	45	0	0	0
101-200	0	0	67	92	17	0	5	58	83	33	0	55	100	8	8
201-300	0	0	0	8	83	0	0	0	9	59	0	0	0	92	92
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	100	50	8	0	100	84	33	8	0	100	89	17	17	0
101-200	0	0	50	92	67	0	16	67	59	33	0	11	75	42	50
201-300	0	0	0	0	33	0	0	0	33	67	0	0	8	41	50
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-100	95	24	25	8	8	100	93	80	10	40					
101-200	5	76	75	8	8	0	7	20	80	60					
201-300	0	0	0	84	76	0	0	0	10	0					
301-400	0	0	0	0	8	-	-	-	-	-					

Table 3. Breakdown of *Crataegus coccinea* L. plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	83	25	0	100	100	50	17	18	100	90	8	0	0
021-040	0	0	17	75	100	0	0	50	83	82	0	10	92	92	42
041-060	-	-	-	-	-	-	-	-	-	-	0	0	0	8	58
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	100	75	17	100	100	83	33	25	100	100	100	83	25
021-040	0	0	0	25	83	0	0	17	67	75	0	0	0	17	75
041-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	100	58	17	17	100	100	100	80	70					
021-040	0	0	42	83	75	0	0	0	20	30					
041-060	0	0	0	0	8	-	-	-	-	-					

CRATAEGUS CRUS-GALLI L.

Family:	Rosaceae
English name:	Cockspur Hawthorn
French name:	Aubépine ergot-de-coq
Category:	Deciduous plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

This small, flat-topped tree can grow to a height of 7-10 m and is almost as wide as it is high.

The straight, short trunk is covered with dark grey bark that becomes scaly with age. The widely spreading, highly branched horizontal branches have rigid thorns, 8 cm long and sometimes curved. The species can also be grown as a multi-stemmed shrub.

The dense foliage is made up of simple, oval leaves pointed at the apex, which are coriaceous and glossy dark green above. The leaves turn light orange to red in fall.

The corymbs of white flowers bloom in May and June, and have a fragrance that some find unpleasant.

The fruits are dark red berries measuring 12 mm in diameter. They appear in August, remain on the tree until late in the season and are popular with birds.

This species has a taproot. It is slow growing.

ORIGIN AND DISTRIBUTION

Possible origins of the name of the genus (*Crataegus*) include "crataegos", which is Greek for "a type of spiny shrub" or "kratos", which is Greek for "strength and ruggedness".

This species, which is native to eastern and central North America, has been known since 1697. Its natural range extends from southern Ontario to Texas and South Carolina. It is often found in abandoned pastures, particularly on rocky ground.

USE

Ornamental: This species can be used as a specimen plant, screen, or protective hedge, or in mass plantings and for naturalization. Its flowers, fruit and bright fall leaves make it particularly attractive. Watch out for the sharp thorns.

Value to birds: The species attracts many birds.

REQUIREMENTS

This species requires a sunny exposure. It is adapted to all soils, even calcareous soils. It prefers moderately moist sites or dry sites. Very hardy, it tolerates urban pollution but not road salt. Pruning should be done after flowering ends.

DISEASES AND INSECTS

The species has average susceptibility to verticillium wilt and rusts, as well as to red spider mites, leaf miners and caterpillars.

PROPAGATION

Seeds: The seeds have an extremely hard seed coat and the embryo is dormant. Under natural conditions, germination may take several years. Some horticulturists recommend that the fruits be harvested before they are completely ripe, to extract the seeds, which then undergo scarification for 10 months. Germination can be accelerated by immersing the seeds in sulphuric acid (scarification) for up to 60 minutes. It is recommended that the taproot be trimmed before planting the seedlings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were collected in September 1989 from a roughly 30-year old parent plant

measuring 4 m high. On November 3, the seeds were placed in peat moss and kept at 20 °C for 55 days. On January 21, 1990, the temperature was lowered to 0-5 °C; cold scarification continued for almost four months. On May 15, the seeds were planted 10 mm deep in a Promix® and sand medium (1:2; v:v) in a shaded cold frame (63 %). On October 23, the seedlings were dug up, puddled and heeled in for the winter. The survival rate was 100 %. On April 23, 1991, they were wrapped and placed in the cold store at 4 °C to await shipping in May.

Inclusion in testing network: Young seedlings 7-10 cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Their winter survival and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died during the first winter and another suffered mechanical breakage due to climatic conditions during the second winter. Frost damage to the branch tips was found at the end of the second winter.

At Sainte-Clotilde and Saint-Hyacinthe, one seedling suffered rodent damage during the first winter and light frost damage to the branch tips was observed in a number of plants. No other damage was observed during the other four winters.

Region 2

At Sainte-Foy, a seedling died shortly after transplanting and frost damage to the branch tips was observed in 37 % of seedlings during the second winter. No other damage was observed.

At Deschambault, one seedling suffered frost damage to the previous year's shoots and another seedling had damage to the aerial portion above the ground level during the first winter. One plant suffered mechanical breakage due to the climatic conditions during the third winter. Frost damage to the branch tips occurred in 16 %, 8 % and 8 % of plants during the second, third and fifth winters.

At La Pocatière, frost damage to the branch tips was observed in 33 %, 72 %, 25 %, 25 % and 18 % of plants over the five winters. In addition, one seedling had frost damage to the old wood during the second winter, while another plant suffered mechanical breakage due to the climatic conditions. No subsequent damage was observed.

Region 3

At Normandin, three seedlings died the first winter and 25 % of seedlings suffered frost damage to the old wood. Frost damage to the branch tips was observed during the first three winters and the last winter in 33 % to 100 % of plants.

At Kapuskasing, two seedlings died the first winter and another the third winter. One plant suffered frost damage down to the ground level during the fourth winter, while damage to the one-year-old shoots was observed in 27 % and 20 % of plants during the third and fifth winters. Frost damage to the branch tips was observed during all five winters in 10 % to 30 % of the trees.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the trees after five years of testing at each site in the three regions.

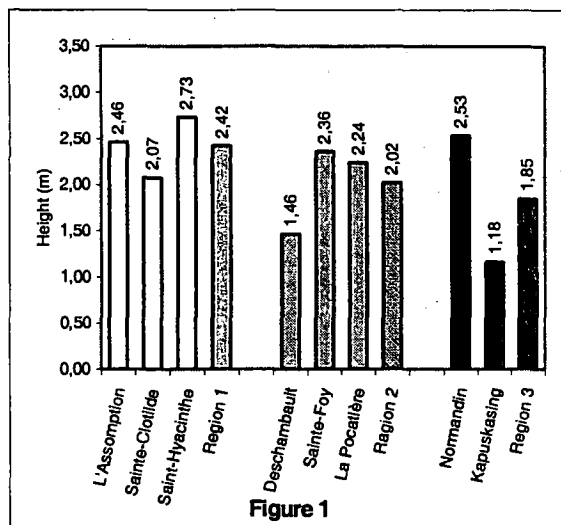


Figure 1. Mean height of trees at trial's end at each of the eight sites and the three regions

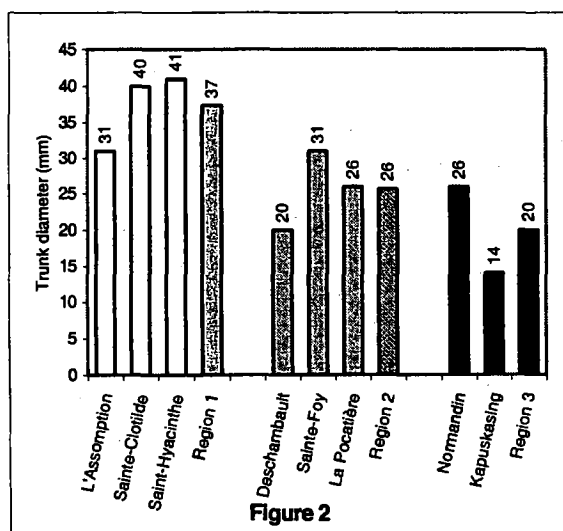


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and the three regions

At Kapuskasing, the height of the trees at the end of the tests was less than half the height obtained at Normandin. The trunk diameter at Kapuskasing was one third less than that at Normandin.

Effect of pruning

Only training was required.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and trunk diameter are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and trunk diameter.

Production of the species is possible at all sites except Kapuskasing. After three growing seasons, 75 % of the trees exceeded 1 m in height, except at Deschambault and Kapuskasing. The trees at Sainte-Clotilde and Saint-Hyacinthe had trunk diameters ranging between 20-40 mm, while diameters of 11-20 mm were observed at the other sites.

HARDINESS EVALUATION

According to the literature consulted, this species' hardiness extends to zone 2b. The test results show that the species can survive to at least zone 2a, and that indeed the species can be used as far north as zone 2a, with the provisos that frost damage may occur and growth will be much slower. The species achieves its natural shape better in zone 2b. Full ornamental potential was achieved at the zone 5 sites.

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Table 1. Frequency of winter damage observed on *Crataegus crus-galli* L. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE*									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	88	10					1		1		12
Sainte-Clotilde	94	5								1	6
Saint-Hyacinthe*	95	3								2	5
REGION 2											
Deschambault	91	6	1			1			1		9
Sainte-Foy	93	7									7
La Pocatière	64	33	1						2		36
REGION 3											
Normandin	41	51	5				3				59
Kapuskasing	64	21	9			2	4				36

* Key:

- 1 = no damage
 2 = damage to the tip of the previous year's shoot
 3 = frost damage on the flower buds
 4 = previous year's shoot affected
 5 = old wood affected
 6 = dead down to the level of snow cover

- 7 = dead down to the ground surface
 8 = dead
 9 = sunscald, trunk spitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

*Damage was evaluated over a four-year period.

No damage of type 3, 5, 6 and 9 occurred for this species.

Table 2. Breakdown of *Crataegus crus-galli* L. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	17	0	0	0	90	20	0	0	0	-	9	0	0	0
051-100	0	66	25	0	0	10	65	8	0	0	-	29	8	0	0
101-150	0	17	67	8	0	0	15	58	0	0	-	48	42	0	0
151-200	0	0	0	75	0	0	0	34	75	50	-	14	33	42	17
201-250	0	0	8	8	75	0	0	0	25	50	-	0	17	33	25
251-300	0	0	0	9	17	-	-	-	-	-	-	0	0	25	25
301-350	0	0	0	0	8	-	-	-	-	-	-	0	0	0	17
351-400	-	-	-	-	-	-	-	-	-	-	-	0	0	0	16

REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	95	58	17	0	0	94	5	8	0	0	100	22	0	0	0
051-100	5	42	67	33	0	6	58	0	8	0	0	72	25	0	0
101-150	0	0	16	58	58	0	37	58	0	0	0	6	50	33	8
151-200	0	0	0	9	42	0	0	34	67	8	0	0	25	25	25
201-250	-	-	-	-	-	0	0	0	25	58	0	0	0	33	42
251-300	-	-	-	-	-	0	0	0	0	34	0	0	0	9	17
301-350	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
351-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

REGION 3										
Height (cm)	Normandin					Kapuskasing				
	91	92	93	94	95	91	92	93	94	95
001-050	45	0	0	0	0	95	100	55	10	0
051-100	55	6	0	0	0	5	0	27	80	14
101-150	0	59	42	25	0	0	0	18	10	86
151-200	0	35	58	25	0	-	-	-	-	-
201-250	0	0	0	50	50	-	-	-	-	-
251-300	0	0	0	0	50	-	-	-	-	-
301-350	-	-	-	-	-	-	-	-	-	-
351-400	-	-	-	-	-	-	-	-	-	-

*Datan were collected since 1992.

Table 3. Breakdown of *Crataegus crus-galli* L. plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	61	8	0	0	90	5	0	0	0	-	-	0	0	0
011-020	0	39	75	0	0	10	95	8	0	0	-	-	0	0	0
021-030	0	0	17	92	67	0	0	83	50	0	-	-	92	17	17
031-040	0	0	0	8	25	0	0	9	42	58	-	-	8	75	25
041-050	0	0	0	0	8	0	0	0	8	34	-	-	0	8	50
051-060	-	-	-	-	-	0	0	0	0	8	-	-	0	0	25
061-070	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
071-080	-	-	-	-	-	-	-	-	-	-	-	-	0	0	8
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	95	84	50	17	0	100	0	0	0	0	95	84	50	17	0
011-020	5	16	50	67	58	0	89	42	0	0	5	16	50	67	58
021-030	0	0	0	16	42	0	11	58	83	42	0	0	0	16	42
031-040	-	-	-	-	-	0	0	0	8	58	-	-	-	-	-
041-050	-	-	-	-	-	0	0	0	9	0	-	-	-	-	-
051-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
061-070	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
071-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	100	29	8	0	0	100	88	82	40	14					
011-020	0	71	83	33	17	0	12	18	60	86					
021-030	0	0	9	67	50	-	-	-	-	-					
031-040	0	0	0	0	33	-	-	-	-	-					
041-050	-	-	-	-	-	-	-	-	-	-					
051-060	-	-	-	-	-	-	-	-	-	-					
061-070	-	-	-	-	-	-	-	-	-	-					
071-080	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1993.

CRATAEGUS SUBMOLLIS SARG.

Family:	Rosaceae
English name:	Downy Hawthorn, Quebec Hawthorn
French name:	Aubépine duveteuse, aubépine du Québec
Category:	Deciduous plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

This small native tree, with a rounded crown flattened at the top, can reach a height of 8 m.

The distinct, crooked trunk is covered with silvery grey bark with longitudinal ridges.

The dwarf twigs often bear terminal flower clusters and fruit. Two types of twigs are found in this genus: long straight shoots and zigzag shoots. The lustrous shoots are pale grey to orange-brown in colour.

The winter buds are reddish brown, rounded and almost as wide as they are long. They are smooth, shiny and covered with imbricated scales. Lateral buds, often occurring in twos or threes, develop into a new shoot bearing leaves or flowers and a thorn. The leaf scars are narrow and slightly elevated, with three vein scars.

The coarsely double serrate to shallowly lobed leaves are widest below the middle. Oval and acuminate at the apex, they measure 5-8 cm in length. They are rugose above and slightly pubescent below, particularly around the veins.

The fairly broad (2.5 cm) white flowers are grouped in corymbs and borne on dwarf shoots. Each flower consists of five white petals, 5-25 stamens and 1-5 carpels. The flowers are very showy and bloom somewhat later than those of *Malus*.

The fruits, known as haws, look like miniature scarlet pears, becoming dull crimson as they ripen. They measure 1.0 cm to 1.5 cm across and persist through the winter.

The thorns are long and thin and few in number.

ORIGIN AND DISTRIBUTION

This small tree grows from eastern Canada to Texas. It is commonly found in moist soils, along the edges of highways and in forest clearings. The species has been known since 1830.

USE

Ornamental: Although care must be taken with the thorns, this species can be used as a specimen plant in small gardens. In mass plantings in large-scale landscapes, it is spectacular in spring. The species can also be used as a small street tree, since it has a wider canopy than the other members of its genus.

Wildlife: The thin flesh of the fruits is much appreciated by birds and mammals. Mammals are particularly efficient seed dispersers.

REQUIREMENTS

Crataegus species prefer calcareous soils and sunny exposures. Pruning should be done after flowering ends. The species is recognized for being resistant to air pollution.

DISEASES AND INSECTS

Cedar rust diseases (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases that begin their life cycle on *Juniperus* and require an intermediate host. Several species in the Rosaceae family, including hawthorns, are particularly susceptible. Other fungal diseases that may occur in the species include powdery mildew (*Podosphaera* sp.) and grey mould rot (*Botrytis* sp.).

The species is very susceptible to fireblight (*Erwinia amylovora*) when conditions are favourable for the disease.

Roundheaded apple tree borer (*Saperda candida*) is a boring insect that also attacks the species. Other pests include eastern tent caterpillar (*Malacosoma americanum*) and Japanese beetle (*Popillia japonica*), which can cause temporary or permanent damage (death of portions of the branches or the entire tree).

PROPAGATION

Seeds: This is the best propagation method for the species. Fruits should be harvested in early fall and the pericarp allowed to rot. The seeds are then extracted and stratified in sand or peat moss. Planted the second autumn, the seeds will germinate the following May.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The fruits were collected on September 27, 1989. After the pericarp was allowed to rot, the seeds were extracted manually, then put in storage. Stratification began on November 3, when the seeds were placed in wet peat moss and kept at 25 °C. On January 21, 1990, the temperature was set at 5 °C and remained so until May 15. The seeds were planted 10 mm deep in a Promix® and sand medium (1:2; v:v) and shaded with a cloth (63 %). The seeds germinated 152 days later. On May 23, 1991, the seedlings were transplanted to the nursery and grown until fall, when they were dug up, puddled and heeled in for the winter. In mid-April 1992, they were wrapped and placed in the cold store to await shipping.

Inclusion in testing network: Young seedlings 5-cm tall were planted at eight test sites throughout Quebec and

northeastern Ontario. Their winter survival and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

At most of the sites, a few seedlings died shortly after transplanting. However, at Deschambault, 46 % of seedlings did not make it.

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, no damage occurred.

At Sainte-Clotilde, one plant died the fourth winter.

At Saint-Hyacinthe, 42 % of trees were damaged by rodents the last winter.

Region 2

At Sainte-Foy, one seedling died the first winter. The third and fifth winters, 8 % and 100 % of plants suffered mechanical breakage.

At Deschambault, frost damage to the branch tips occurred in a single seedling during the second winter. Mechanical breakage was noted in 9 % and 18 % of trees during the third and fifth winters.

At La Pocatière, one seedling died the first winter. The following winter, one seedling suffered frost damage to the branch tips, while another had mechanical damage the third winter.

Region 3

At Normandin, the branch tips were affected in 35 % and 8 % of plants during the second and fourth winters. The last winter, 25 % of plants suffered mechanical breakage.

At Kapuskasing, one seedling died the first winter. Frost damage to the branch tips occurred in 5 %, 33 % and 8 % of trees during the first two winters and the fourth winter. The one-year-old shoots were damaged in 8 % of trees the third and fourth winters and 25 % of trees had mechanical breakage during the last winter.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the trees after five years of testing at each site in the three regions.

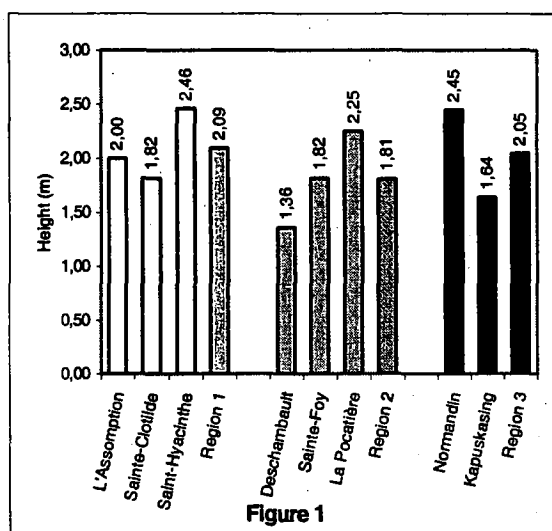


Figure 1. Mean height of trees at trial's end at each of the eight sites and the three regions

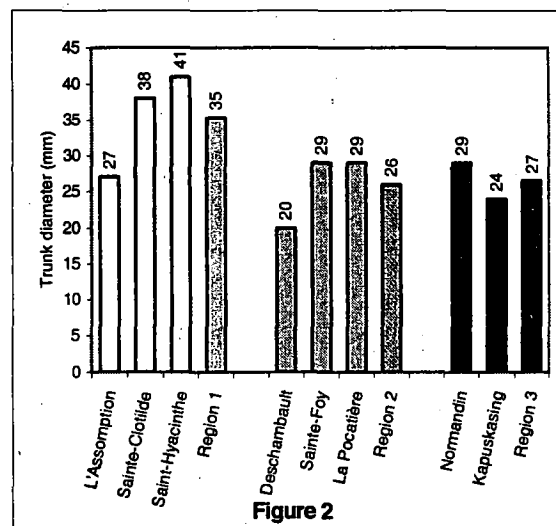


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and the three regions

Effect of pruning

Only training was required.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and trunk diameter are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and trunk diameter.

Three growing seasons were required for 70 % to 100 % of plants to reach over 1 m in height at Saint-Hyacinthe, La Pocatière, Normandin, Sainte-Clotilde and Sainte-Foy. A fourth year was required at L'Assomption and Kapuskasing.

HARDINESS EVALUATION

According to the literature consulted, this species' hardiness extends to zone 2b. The test results show that, for this seed provenance, the species can survive and be used as far as zone 2a.

Notwithstanding the mechanical breakage that occurred, the species' full ornamental potential was achieved at all zone 4 and 5 sites.

BIBLIOGRAPHIC REFERENCES

3, 7, 9, 32

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Table 1. Frequency of winter damage observed on *Crataegus submollis* Sarg. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	9	10	11		
REGION 1											
L'Assomption	100									0	
Sainte-Clotilde	98						2			2	
Saint-Hyacinthe*	92								8	8	
REGION 2											
Deschambault	93	2						5		7	
Sainte-Foy	77						1	22		23	
La Pocatière	96	1					1	2		4	
REGION 3											
Normandin	86	9						5		14	
Kapuskasing	81	10	3				1	5		19	

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period

No damage of type 3, 5, 6, 7 and 9 occurred for this species.

Table 2. Breakdown of *Crataegus submollis* Sarg. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	78	0	0	0	100	23	0	0	0	100	0	0	0	0
051-100	0	22	83	8	0	0	77	25	17	0	0	84	0	0	0
101-150	0	0	17	50	0	0	0	0	33	36	0	16	42	0	0
151-200	0	0	0	42	58	0	0	0	42	9	0	0	58	50	0
201-250	0	0	0	0	42	0	0	0	8	55	0	0	0	50	50
251-300	-	-	-	-	-	-	-	-	-	-	0	0	0	0	50
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	38	0	0	0	100	32	8	0	0	100	16	0	0	0
051-100	0	62	64	46	0	0	68	25	25	8	0	79	17	8	8
101-150	0	0	36	45	73	0	0	67	17	17	0	5	66	8	0
151-200	0	0	0	9	27	0	0	0	58	25	0	0	17	42	17
201-250	-	-	-	-	-	0	0	0	0	50	0	0	0	42	42
251-300	-	-	-	-	-	-	-	-	-	-	0	0	0	0	33
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	95	10	0	0	0	100	44	25	0	0					
051-100	5	75	25	0	0	0	50	50	17	8					
101-150	0	15	75	25	8	0	6	25	50	33					
151-200	0	0	0	50	17	0	0	0	33	42					
201-250	0	0	0	25	8	0	0	0	0	17					
251-300	0	0	0	0	67	-	-	-	-	-					

Table 3. Breakdown of *Crataegus submollis* Sarg. plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	100	67	0	100	83	50	8	9	100	100	25	0	0
021-040	0	0	0	33	100	0	17	50	83	55	0	0	75	100	58
041-060	-	-	-	-	-	0	0	0	9	36	0	0	0	0	42
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	100	100	55	100	100	92	25	17	100	100	75	33	17
021-040	0	0	0	0	45	0	0	8	75	83	0	0	25	67	75
041-060	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	100	92	25	17	100	100	100	58	33					
021-040	0	0	8	75	83	0	0	0	42	67					
041-060	-	-	-	-	-	-	-	-	-	-					

DAPHNE CNEORUM PALL.

Family:	Thymeleaceae
English name:	Garland Flower Daphne
French name:	Daphné odorant
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small, rounded shrub with downy, spreading twigs can reach a height of 0.35 m and a spread of over 1.00 m.

The dense, persistent foliage consists of narrow, entire leaves, 2 cm long and about 1 cm wide. The leaves are glabrous, simple, alternate and short stalked; they have a dark lustrous green upper surface and glaucous underside, and stand out from the twigs.

The fragrant, pink flowers are borne on the branch tips. The sepals are oblong and have short peduncles. The perianth measures 8-10 mm and the striped tube has a downy exterior. The flowers form corymbs of 6-8 blooms, and in the spring the numerous flowers cover the entire plant. A second flowering, but with fewer blooms, occurs at the end of the season.

The tiny drupes turn yellow in fall, then brown at maturity.

The root system is shallow and consists of many fine roots.

ORIGIN AND DISTRIBUTION

This species, known to be cultivated since 1752, is native to central and southern Europe.

USES

Ornamental: This species, featured in rock gardens and beds, is highly prized in landscaping for its carpeting habit and its abundant and very fragrant blooms.

DISEASES AND INSECTS

The Réseau d'avertissements phytosanitaires has no references to this species. At Deschambault, the plants were found to have some yellow leaves, likely caused by drought.

REQUIREMENTS

This plant requires a sunny situation in order to produce its spectacular blooms. It is indifferent to soil type, but nonetheless prefers cool, rich, calcareous soils. Snow cover is needed to prevent foliage browning. No pruning is necessary. A slow-growing species, it has difficulty recovering from transplanting and establishing itself.

Occasionally, these plants die for no apparent reason.

PROPAGATION

Seeds: The drupes are collected as soon as they start to change colour. They are placed outside in flats to undergo natural stratification. The following spring, the seedlings are transplanted upon emergence in a medium consisting mainly of cool, moist peat; the pots must be kept out of the sunlight.

Cuttings: Cuttings are taken in summer from stems that have already flowered and are treated with a 10,000-ppm IBA solution.

Layering: Layering of external shoots, held down by weights, appears to produce excellent results. Branchlets that undergo this treatment in June-July root a month later. The seedlings thus obtained can be transplanted to cold frames. The following year, the layers are cut back and partly covered with a layer of peat. They will then form 4-6 branchlets. This method is useful for obtaining low-growing, bushy plants.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: 320 cuttings 7-10 cm long were taken on June 7, 1987 from parent plants measuring 25 cm tall and 40 cm wide. They were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution, planted in plug trays filled with a Promix®-perlite (1:1; v:v) medium and placed under a mist unit operating for 30 seconds every 10 minutes. The rooting period lasted 7 weeks. On August 20, the cuttings were placed in glass coldframes outdoors to overwinter. The winter survival rate was 100 %. On May 30, 1988, 240 seedlings were potted up in Fertil Pots® and grown in beds until they were shipped in May 1991. The survival rate was 100 %.

Inclusion in testing network: Young seedlings 12 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness rate and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

A few seedlings died after transplanting at five of the eight test sites.

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 11 %, 19 % and 44 % of the plants died the first three winters. The branch tips suffered frost damage the first two winters and the fourth winter in 39 %, 38 % and 60 % of the shrubs. Flower bud mortality was recorded in 37 % of the seedlings after the second winter. Three seedlings suffered damage to the aerial portion above the snow cover the first winter and 60 % of shrubs had foliage browning the last winter.

At Sainte-Clotilde, 35 % of the seedlings died the first winter. Foliage browning was observed in 78 % and 100 % of the shrubs during the third and fifth winters. In addition, the aerial portion of all shrubs had frost damage extending down to the snow cover the fourth winter.

At Saint-Hyacinthe, 71 %, 17 % and 25 % of the shrubs died the first three winters. One shrub exhibited foliage browning damage the first winter. The branch tips of 5 %, 33 % and 67 % of the plants were damaged by frost during the first two winters and the last winter. In addition, 33 % of shrubs had frost damage to the previous year's shoots the fourth and fifth winters.

Region 2

At Sainte-Foy, one seedling did not survive the first winter. The first four winters, 52 %, 90 %, 82 and 18 % of shrubs had frost damage to the stem tips. Damage to the one-year-old shoots was observed in 24 %, 10 % and 18 % of plants the first three winters and 19 % of the plants suffered damage to the old wood the first winter.

At Deschambault, 16 % of the seedlings died the first winter and one seedling died during each of the following two winters. Frost damage to the branch tips was observed every winter, with 42 %, 81 %, 67 %, 46 % and 18 % of plants being affected respectively. The first three winters, 5 %, 6 % and 17 % of the shrubs suffered frost damage to the one-year-old shoots. Mechanical breakage occurred in 27 % of the shrubs the last year.

At La Pocatière, no damage occurred in the first and last years and one seedling died the second winter. Frost damage to the branch tips was observed in 53 % and 45 % of plants during the second and third winters. The one-year-old shoots suffered frost damage in 16 %, 36 % and 91 % of the plants the second, third and fourth winters.

Region 3

At Normandin, all of the seedlings died during the first three winters.

At Kapuskasing, some seedlings died each winter, with mortality affecting 28 %, 23 %, 11 %, 13 % and 14 % of the plants over the five years. The first two winters, 17 % and 38 % of the seedlings suffered frost damage to the branch tips. The previous year's shoots froze in 8 %, 11 % and 50 % of plants the second, third and fourth winters. The branches of 11 % and 13 % of the shrubs froze right down to the ground level during the first and fourth winters. In addition, mechanical breakage occurred in 8 % of the shrubs in the second winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

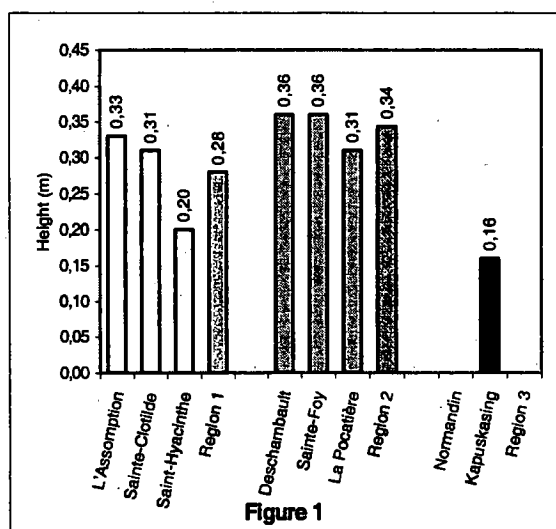


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

The values obtained at Saint-Hyacinthe reduced the mean for its region. Height values were particularly homogeneous within region 2. Widths were also fairly homogeneous within regions 1 and 2. Region 3 consisted solely of Kapuskasing, since the Normandin seedlings all died. All of the seedlings were wider than tall as of the second year.

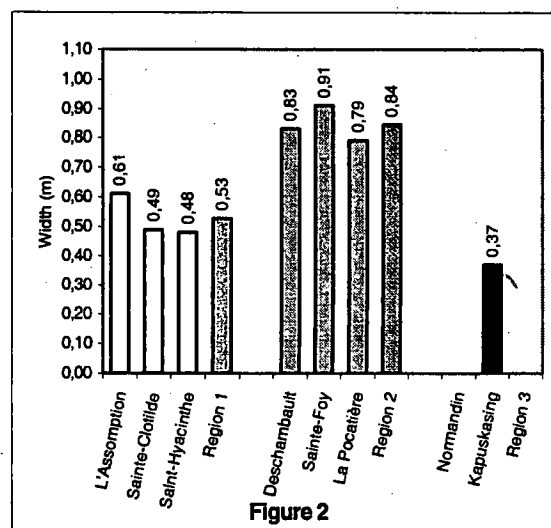


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning was done except light pruning to deal with frost damage.

Flowering

Flowering was observed at all the sites almost every year, except at Normandin. In general, the plants produced an initially abundant crop of flowers over a 30-day period; this was followed in some cases by a second, but less abundant, episode of flowering.

Flowering generally lasted 22-50 days, with an average period being 30 days. Regardless of the year of evaluation, flowering began on the same date, indicating that the plant's age has no effect on flowering.

At the three region 1 sites, the first flowers were observed between May 15 and 20. In region 2 and at Kapuskasing, they appeared 5 to 8 days later. At Kapuskasing, flowering began to be uniform among the plants in the third year of evaluation.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and

width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

The seedlings grown in pots showed good recovery after transplanting, taking into consideration that this species is difficult to transplant in bare root form. Production is possible in regions 1 and 2, but the plants need appropriate protection from winter frost. Growth was similar at all the sites in these regions; it took two years to obtain seedlings measuring more than 21 cm wide. The cuttings were 4 years old at the time of establishment.

HARDINESS EVALUATION

According to the literature, this species is hardy to zone 2b. However, all the seedlings at Normandin died during the first three winters and, although all those at Kapuskasing survived, a number of them died during the trial, pointing to a gradual weakening of the plants. These results indicate that the species' survival is not assured in zone 2 and that it is most likely limited to zone 3.

Despite the similar number of undamaged seedlings at each of the sites in regions 1 and 2, the severity of the damage differed for these two regions. In region 2, frost damage most often affected the branch tips and the current year's shoots, whereas in region 1, mortality, frost damage down to the snow cover and foliage browning were more common. The plant can be used as far as zone 4, given that frost-injured plants generally recovered the following year in that zone.

Full ornamental potential was not achieved at the sites tested.

BIBLIOGRAPHIC REFERENCES

2, 7, 8, 9, 17, 21, 25, 26, 29, 31, 34, 35, 39, 67

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Table 1. Frequency of winter damage observed on *Daphne cneorum* Pall. from 1992 to 1996

Test site	Nodamage ¹	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
		2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	35	27	8			3		15				12	65
Sainte-Clotilde	37					20		7				36	63
Saint-Hyacinthe	42	21		13				23				1	58
REGION 2													
Deschambault	32	51		6			6			5			68
Sainte-Foy	37	48		10	4			1					63
La Pocatière	51	19		29				1					49
REGION 3													
Normandin	16	3						81					84
Kapuskasing	51	11		14			5	18		1			49

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

No damage of type 9 and 11 occurred for this species.

Table 2. Breakdown of *Daphne cneorum* Pall. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	11	0	0	0	0	24	9	0	0	0	-	0	0	0	0
011-020	83	75	22	0	0	76	91	22	33	0	-	86	80	100	67
021-030	6	25	44	60	20	0	0	78	67	56	-	14	20	0	33
031-040	0	0	34	40	80	0	0	0	0	44	-	-	-	-	-
041-050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	16	0	0	0	0	29	0	0	0	0	11	0	0	0	0
011-020	63	50	9	0	0	66	50	0	0	0	84	79	9	0	0
021-030	21	50	73	36	0	5	50	67	18	18	5	21	91	64	45
031-040	0	0	18	55	91	0	0	33	82	73	0	0	0	36	55
041-050	0	0	0	9	9	0	0	0	0	9	-	-	-	-	-
REGION 3															
Height (cm)	Normandin**					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	38	70	0	-	-	61	31	0	0	0					
011-020	62	30	0	-	-	39	69	100	87	100					
021-030	0	0	100	-	-	0	0	0	13	0					
031-040	-	-	-	-	-	-	-	-	-	-					
041-050	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

**Dats were collected from 1991 to 1993.

Table 3. Breakdown of *Daphne cneorum* Pall. plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	83	13	0	0	0	88	9	0	0	0	-	14	0	0	0
021-040	17	75	56	0	0	12	91	11	13	25	-	71	60	33	0
041-060	0	12	44	100	75	0	0	89	87	75	-	15	40	67	100
061-080	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	47	0	0	0	0	29	0	0	0	0	84	16	0	0	0
021-040	53	33	17	0	0	71	30	11	0	0	16	63	10	0	0
041-060	0	67	83	25	0	0	70	67	30	0	0	21	90	60	10
061-080	0	0	0	75	40	0	0	22	70	18	0	0	0	0	50
081-100	0	0	0	0	60	0	0	0	0	45	0	0	0	40	40
101-120	-	-	-	-	-	0	0	0	0	37	-	-	-	-	-
REGION 3															
Width (cm)	Normandin**					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	95	90	100	-	-	100	62	11	0	0					
021-040	5	10	0	-	-	0	38	89	38	71					
041-060	-	-	-	-	-	0	0	0	62	29					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

**Datan were collected from 1991 to 1993.

FORSYTHIA X OVATA

'HAPPY CENTENNIAL'

Family:	Oleaceae
English name:	Happy Centennial Forsythia
French name:	Forsythie 'Happy Centennial'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This compact shrub grows to a height of 0.6 to 0.8 m and a spread of 1.0 to 1.5 m.

Its many twigs, with greying bark, arise directly out of the ground.

The small lanceolate and shiny leaves give the shrub a dense but delicate look.

Many amber yellow, slightly fragrant flowers grow all along the twigs. They appear before leaf-out early in spring and have a diameter of 3-4 cm.

This shrub, with its many fibrous roots, is slow growing.

ORIGIN AND DISTRIBUTION

This cultivar comes from a hybrid (*Forsythia ovata* 'Ottawa' x *F. europaea*) and a selection called F18 obtained in 1986 by Ms Felicitas Svjeda, a hybridizer with Agriculture and Agri-Food Canada in Ottawa.

USE

Ornamental: This shrub, prized for its early spring flowering, is used in mass plantings or incorporated into large, mixed landscapes.

REQUIREMENTS

The shrub requires full sun. Although not very exacting, it prefers light, fertile soil. It is easy to transplant and the floral buds are quite cold hardy. Occasional pruning is needed to remove old wood.

DISEASES AND INSECTS

To our knowledge, forsythia species are subject only to attack by grey mould (*Botrytis* sp.), when conditions are favourable for its development.

Some years, the red-headed flea beetle (*Systema frontalis*) can be very detrimental to the development of forsythia.

PROPAGATION

Cuttings: Softwood cuttings are taken in late July. Lignified cuttings can also be used.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 387 cuttings (10 cm) were taken on July 4, 1990 from roughly five-year-old parent plants. They were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. The cuttings were then immersed in a fungicide solution (Benomyl-Captan®), planted in a peat-perlite substrate (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 95 % after 130 days. Misting was halted in early October and the seedlings were treated twice with a soluble fertilizer (20-20-20, 200 ppm nitrogen), one week apart. In November, they were removed from the rooting containers and put in the cold store at 0 °C in plastic bags that had been perforated with a hatpin. In May 1991, the seedlings were potted up in Fertil Pots® in a peat-perlite mixture (3:2; v:v) and placed in a tunnel greenhouse for about a month, after which they were moved outdoors to lightly shaded cold frames. They were treated weekly with soluble fertilizer (20-20-20, 200 ppm nitrogen) until mid-September. In November, they were returned to the cold store at 0 °C. In early May 1992, the plants were wrapped and put in the cold store at 4 °C, to be shipped a few days later.

Inclusion in testing network: Seedlings 8-12 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died after transplanting and another plant died during the fourth winter. Frost injury to the branch tips was the only damage observed during the first two winters and the last winter, affecting 65 %, 35 % and 20 % of the shrubs respectively.

No damage occurred at Sainte-Clotilde.

At Saint-Hyacinthe, one plant died the second winter and five others died the third winter. The last winter, four shrubs showed frost damage to the aerial portion above the snow cover.

Region 2

At Sainte-Foy, 35 % of the plants had frost damage to the branch tips during the second and fifth winters.

The only damage at Deschambault occurred during the first two winters: 20 % of the seedlings had frost damage to their entire aerial portion the first winter and 17 % of plants had frost damage to the branch tips the second winter. In addition, 10 % and 6 % of shrubs suffered damage to the one-year-old shoots.

No damage occurred at La Pocatière.

Region 3

Four plants died during the first three winters at Normandin. All of the plants had frost damage to the branch tips during the first few winters. Mechanical breakage affected four shrubs the last winter.

At Kapuskasing, 55 % of the shrubs died the first winter and two others died the following year. Two plants had frost damage to the branch tips the first two winters. As well, two plants exhibited frost injury to the one-year-old shoots and the aerial portion above the snow cover.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

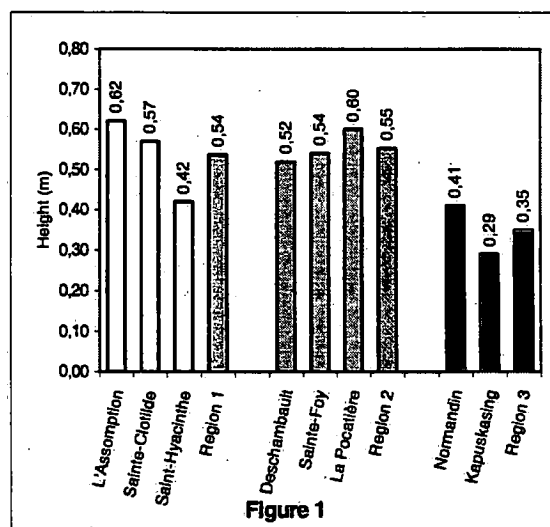


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

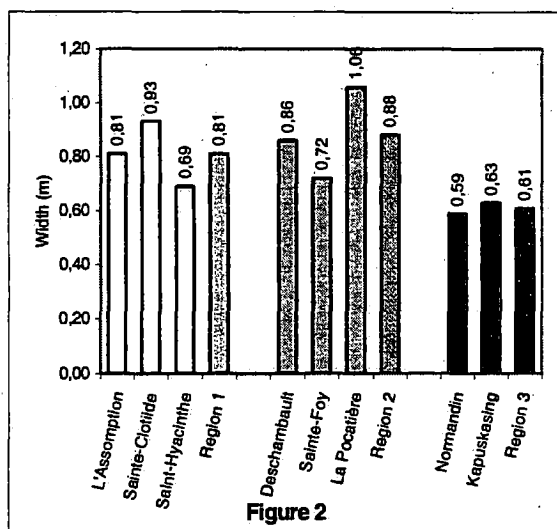


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning was carried out at Sainte-Clotilde, La Pocatière or Kapuskasing. Light pruning was done at the other sites.

Flowering

This species flowers very early in the season. No observation was carried out at Sainte-Clotilde. A few plants flowered at Saint-Hyacinthe the last two years of the trial, whereas at L'Assomption, flowering occurred every year, beginning between April 27 and May 7, and lasting 17-26 days. In region 2, flowering began 6-10 days later and lasted a shorter time (6-19 days). Only a few shrubs flowered in region 3; flowering began around May 15 and lasted 7-13 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Height and width growth was similar for the region 1 and 2 sites, given that nearly 90 % of the shrubs had reached a height of 21-40 cm after two years and a width of 21-60 cm.

This plant can be grown at the sites in hardiness zones 4 and 5.

HARDINESS EVALUATION

This Canadian hybrid showed good survival at the test sites, except at Kapuskasing, where mortality was very high the first winter. The plant will survive in zone 2b, whereas the literature indicates that it can survive as far as zone 4.

This cultivar can be used for its foliage as far as zone 2b; however, flowering is limited there. Full ornamental potential was achieved in zone 5b at Sainte-Clotilde, as well as in zone 4b at La Pocatière, where the first frosts were delayed by the buffering effect of the water mass of the St. Lawrence River. The cultivar requires good snow cover throughout the coldest period of winter.

BIBLIOGRAPHIC REFERENCES

3, 7, 16, 31

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Table 1. Frequency of winter damage observed on *Forsythia x ovata* 'Happy Centennial' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	73	24						3			27
Sainte-Clotilde	100										0
Saint-Hyacinthe	85					4	11				15
REGION 2											
Deschambault	59	3		3			4	4	27		41
Sainte-Foy	86	14									14
La Pocatière	100										0
REGION 3											
Normandin	48	32						8	12		52
Kapuskasing	74	7		1			2	16			26

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Forsythia x ovata* 'Happy Centennial' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	90	10	0	0	0	100	10	0	0	0	95	20	29	0	0
021-040	10	85	42	33	10	0	90	75	33	0	5	80	57	67	67
041-060	0	5	58	50	40	0	0	25	58	75	0	0	14	33	17
061-080	0	0	0	17	40	0	0	0	9	25	0	0	0	0	16
081-100	0	0	0	0	10	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	39	9	0	0	95	0	0	0	0	100	5	0	0	0
021-040	0	61	91	55	9	5	95	58	33	0	0	90	17	8	0
041-060	0	0	0	45	91	0	5	42	42	75	0	5	67	58	58
061-080	-	-	-	-	-	0	0	0	25	25	0	0	16	34	34
081-100	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
REGION 3															
Height (cm)	Normandin					Kapuskaing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	69	11	0	0	94	100	50	25	0					
021-040	0	31	78	66	50	6	0	50	75	100					
041-060	0	0	11	34	50	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Forsythia x ovata* 'Happy Centennial' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	5	0	0	0	0	67	5	0	0	0	60	5	0	0	0
021-040	95	80	25	0	0	33	85	0	0	0	40	20	29	0	16
041-060	0	20	58	25	10	0	10	58	0	0	0	70	43	33	17
061-080	0	0	17	67	30	0	0	42	42	17	0	5	28	50	50
081-100	0	0	0	8	50	0	0	0	50	75	0	0	0	17	17
101-120	0	0	0	0	10	0	0	0	8	8	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	55	11	0	0	0	20	0	0	0	0	76	0	0	0	0
021-040	45	50	0	0	0	80	25	0	0	0	24	19	0	0	0
041-060	0	39	100	27	0	0	60	33	0	0	0	81	0	0	0
061-080	0	0	0	73	36	0	15	67	8	92	0	0	50	0	0
081-100	0	0	0	0	54	0	0	0	92	8	0	0	50	100	25
101-120	0	0	0	0	10	-	-	-	-	-	0	0	0	0	75
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	23	0	0	0	67	50	0	0	0					
021-040	0	77	78	0	0	33	50	50	25	0					
041-060	0	0	22	56	63	0	0	50	75	25					
061-080	0	0	0	44	37	0	0	0	0	75					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

GLEDITSIA TRIACANTHOS

INERMIS (L.) ZABEL.

Family:	Leguminous, Caesalpinaceae
English name:	Thornless Honeylocust
French name:	Févier inerme d'Amérique
Synonym:	<i>Gleditsia triacanthos</i> var. <i>inermis</i>
Category:	Deciduous plant
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This tree with an irregular crown, open and rounded at the top, grows to 20 m tall.

The long, graceful branches bear light, open foliage that provides light shade in summer. The leaves appear late in the spring and are bright green, turning light yellow in fall.

Paripinnate compound leaves are borne on flowering dwarf shoots with a pubescent rachis. Each leaf consists of 10-20 pairs of oblong to lanceolate leaflets, with rounded tips and serrulate margins, each 1.5-3.5 cm long.

Bipinnately compound leaves, measuring 12-20 cm, are borne on stouter shoots; the rachis is divided into 8-14 branches containing leaflets 1-2 cm in length.

The greenish-yellow flowers, unisexual or perfect, are inconspicuous. The many male flowers occur in tight racemes 5-6 cm long, while the female flowers are in few-flowered clusters. The flowers appear in late spring or early summer.

The fruits, indehiscent pods, are 16-40 cm long and 2-5 cm wide. They turn brown at maturity, then twist as they dry out, persisting on the tree for some time. Each pod contains a number of hard, shiny brown seeds, surrounded by sweet pulp.

The brown to greyish-brown bark is furrowed into irregular ridges. This non-thorny variety has very few thorns compared to the species.

ORIGIN AND DISTRIBUTION

The genus was named after Gottlieb Gleditch, head of the Berlin Botanical Garden, who died in 1786. This species comes from the central United States.

USE

Ornamental: The species is planted in rows, as a specimen tree or in groups to provide light, dappled shade. Grass grows well under this tree.

REQUIREMENTS

This species thrives in rich, moist soil. It adapts to drier soils, and even poor soil or mixed fill. It is intolerant of shade. It survives transplanting in spring and autumn very well.

DISEASES AND INSECTS

Gleditsia may be attacked by cottony maple scale, an insect which is found on the branches and resembles a half-popped kernel of popcorn.

Honey locust pod gall midges (*Dasineura gleditchiae*) attack the foliage. The young leaflets curl up and galls (round or slightly elongated and 3 mm in diameter) develop on the foliage. As the larva grows, the gall becomes brownish. During severe infestations, the leaflets fall prematurely and even the young twigs can be affected, but new leaves eventually form. Thornless cultivars are particularly susceptible.

Aphids severely attacked the plants at Saint-Hyacinthe, L'Assomption and Sainte-Foy, causing deformities and malformations.

PROPAGATION

This variety is usually propagated by grafting. When propagated by seed, the plants have a fairly large number of thorns.

Seeds: Seeds are harvested in fall and kept in a dry place until sowing. The pods can be collected from the ground when the snow melts, and the seeds extracted and planted right away. If seeds have been stored for a fairly long time, a hot water bath at 60°C for two hours or a sulphuric acid treatment for an hour will promote germination.

Cuttings: Acceptable results can be achieved by planting woody cuttings, taken from fast-growing new shoots, in a bed in spring.

Grafting: Nurseries usually graft horticultural varieties onto the species rootstock. T-budding using bud sticks from two-year-old shoots or bench grafts using bareroot plants both yield good results. Nursery grafting is done in May with scions from two-year-old wood. It is very important to leave sap-drawers.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent-plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds were collected on October 4, 1988, from 35-year-old parent plants over 12 m tall. They were dried and put in storage. On May 12, 1989, the seeds were soaked in a sulphuric acid solution for an hour and then sown 10 mm deep in a Promix® and sand medium (1:3; v:v). Shade (63 %) was provided. Germination began six days later. In fall 1989, the seedlings were dug up, puddled and heeled in for the winter. The survival rate was 100 %. On May 25, 1990, 1,343 seedlings were transplanted in the nursery and grown on until fall. On October 23, 200 seedlings were dug up, puddled, wrapped and heeled in for the winter. On

April 18, 1991, they were wrapped in plastic bags and put in the cold store at 5 °C to await shipping.

Inclusion in testing network: Young seedlings 4-6 cm tall were planted at eight test sites throughout Quebec and northeastern Ontario. Winter survival and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 67 % of the plants died during the fourth winter, most of these having suffered serious damage the preceding winter, with no growth occurring. Frost damage to the branch tips occurred during the first four winters in a decreasing percentage of plants (100 % to 25 %). Damage to the one-year-old shoots was observed after the second and fourth winters in 5 % and 8 % of trees. Damage to the old wood was found in 5 % and 67 % of trees after the second and third winters.

At Sainte-Clotilde, 15 % and 33 % of the plants died during the first two winters. Frost damage to the branch tips occurred in 53 %, 56 % and 8 % of trees during the first three winters. Damage to the one-year-old shoots occurred during the second and third winters in 6 % and 92 % of trees. Frost damage down to the snow cover was observed in 6 % of plants during the second winter.

At Saint-Hyacinthe, damage to the branch tips was observed in 67 %, 100 % and 45 % of the plants the first, third and fourth winters. All seedlings suffered frost damage to the one-year-old shoots during the second winter.

Region 2

At Sainte-Foy, frost damage to the branch tips occurred in roughly 80 % of trees the first two and last two winters. Damage to the one-year-old shoots was recorded after the third, fourth and fifth winters in 67 %, 17 % and 17 % of plants. Damage to old wood was seen after the third winter in 33 % of trees.

At Deschambault, a single plant died during each of the fourth and fifth winters. Frost damage to the branch tips was observed in 38 %, 83 % and 91 % of seedlings during the first winter and the last two winters. Damage to the one-year-old shoots was observed in 62 %, 90 %, 8 % and 8 % of trees during the first four winters. During the third winter, 92 % of trees suffered frost damage down to the ground.

At La Pocatière, 29-83 % of the plants sustained frost damage to the branch tips during the five years of tests. Damage to the one-year-old shoots occurred in 24 %, 57 % and 100 % of trees during the first three winters.

Region 3

At Normandin, 5 %, 19 % and 16 % of plants died the first, third and fourth winters. In addition, 18 % of seedlings were damaged down to the ground level the second winter. Frost damage to the branch tips was observed after every winter (except the second one) in 33-50 % of trees. The first and fourth winters, 62 % and 44 % of trees had frost damage to the old wood. During the second and third winters, 82 % and 9 % of trees froze down to the snow cover.

At Kapuskasing, frost damage to the branch tips was observed in 35 % of plants during the first winter. Frost damage to the one-year-old shoots occurred in 40 %, 83 % and 42 % of trees during the first three winters. Frost damage down to the ground was observed in 17-100 % of trees every winter.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the trees after five years of testing at each site in the three regions.

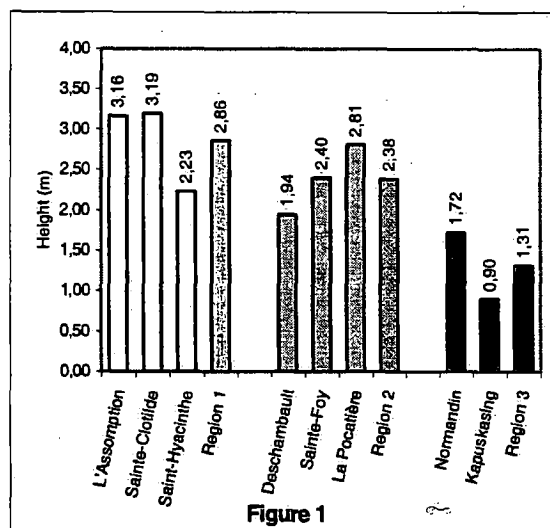


Figure 1. Mean height of trees at trial's end at each of the eight sites and the three regions

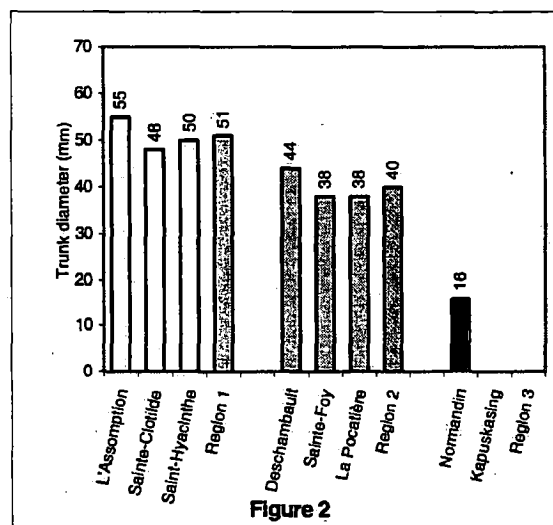


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and the three regions

The mean height of trees at Kapuskasing was only slightly over half that of seedlings at Normandin.

Annual growth was irregular in region 1, fairly stable in region 2 and poorer in region 3.

Effect of pruning

The extent of pruning depended on the degree of winter damage.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and trunk diameter.

Regardless of whether the trees were grown in zone 4 or 5, growth was more rapid under favourable soil conditions (non-clay soils).

After four years, 67-75 % of trees at Saint-Hyacinthe, Sainte-Foy and Normandin were over 1.5 m tall. The following year, a comparable height was achieved in 58 % of trees at L'Assomption, Sainte-Clotilde, Deschambault and La Pocatière. However, the extensive damage observed in this variety leads us to recommend that it be produced in warmer zones than those in the tests.

HARDINESS EVALUATION

According to the literature, this species is hardy to zone 5. The test results corroborate this. Although mortality was not high in zone 2 because of the heavy snow cover, the trees were weak and, in our opinion, could not survive very long under such harsh climatic conditions.

Describing the variety as hardy to zone 4b in terms of use is quite justified, since damage was light but widespread in young plants. Several specimens can be found in the Quebec City region, but these are probably trees with the ability to survive under the region's climatic conditions. Seed provenance is crucial.

The variety achieves full ornamental potential outside the zones tested.

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2, 7, 8, 25, 26, 39, 62, 77

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Table 1. Frequency of winter damage observed on *Gleditsia triacanthos inermis* (L.) Zabel. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	20	50	3	14			13				80
Sainte-Clotilde	47	23	20		1		9				53
Saint-Hyacinthe*	38	42	20								62
REGION 2											
Deschambault	42	34		2		19	3				58
Sainte-Foy	14	59	20	7							86
La Pocatière	13	59	28								87
REGION 3											
Normandin	17	33	21		18	4	7				83
Kapuskasing	7	33				60					93

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period.

No damage of type 3, 9, 10 and 11 occurred for this species.

Table 2. Breakdown of *Gleditsia triacanthos inermis* (L.) Zabel. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	43	8	0	0	100	80	50	8	0	-	-	0	0	0
051-100	0	57	50	8	0	0	20	42	33	33	-	-	25	0	0
101-150	0	0	42	50	9	0	0	8	42	8	-	-	67	25	0
151-200	0	0	0	42	55	0	0	0	17	25	-	-	8	33	33
201-250	0	0	0	0	18	0	0	0	0	17	-	-	0	42	42
251-300	0	0	0	0	9	0	0	0	0	17	-	-	0	0	25
301-350	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	62	33	8	0	100	67	17	0	0	100	74	27	8	0
051-100	0	38	25	25	8	0	33	50	25	8	0	26	45	25	18
101-150	0	0	42	33	34	0	0	16	8	0	0	0	28	33	10
151-200	0	0	0	17	8	0	0	17	42	25	0	0	0	17	0
201-250	0	0	0	17	50	0	0	0	17	25	0	0	0	17	45
251-300	-	-	-	-	-	0	0	0	8	25	0	0	0	0	27
301-350	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	100	45	8	9	10	100	77	45	70	40					
051-100	0	55	25	9	10	0	23	36	10	30					
101-150	0	0	34	9	0	0	0	19	10	10					
151-200	0	0	33	36	10	0	0	0	10	10					
201-250	0	0	0	37	40	0	0	0	0	10					
251-300	0	0	0	0	30	-	-	-	-	-					
301-350	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1993.

Table 3. Breakdown of *Gleditsia triacanthos inermis* (L.) Zabel. plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	67	14	0	0	0	90	10	0	0	0	-	-	0	0	0
011-020	33	57	33	25	9	10	85	33	0	8	-	-	17	0	0
021-030	0	29	34	33	37	0	5	42	34	25	-	-	75	17	8
031-040	0	0	25	17	18	0	0	17	33	17	-	-	8	67	25
041-050	0	0	8	17	36	0	0	8	17	34	-	-	-	16	42
051-060	0	0	0	8	0	0	0	0	8	0	-	-	-	-	25
061-070	-	-	-	-	-	0	0	0	8	8	-	-	-	-	-
071-080	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-

Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	19	8	0	0	78	17	0	0	0	100	16	9	9	0
011-020	0	67	25	25	8	22	56	25	8	0	0	84	55	8	8
021-030	0	14	25	17	17	0	27	42	42	8	0	0	36	58	25
031-040	0	0	33	25	25	0	0	33	25	42	0	0	0	25	34
041-050	0	0	9	16	17	0	0	0	25	25	0	0	0	0	25
051-060	0	0	0	17	17	0	0	0	0	8	0	0	0	0	8
061-070	0	0	0	0	16	0	0	0	0	17	-	-	-	-	-
071-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Trunk diameter (mm)	REGION 3									
	Normandin					Kapuskasing				
	91	92	93	94	95	91	92	93	94	95
001-010	78	15	0	0	10	71	38	28	30	20
011-020	22	80	58	9	0	29	62	45	40	30
021-030	0	5	42	55	20	0	0	27	20	30
031-040	0	0	0	36	30	0	0	0	10	10
041-050	0	0	0	0	30	0	0	0	0	10
051-060	0	0	0	0	10	-	-	-	-	-
061-070	-	-	-	-	-	-	-	-	-	-
071-080	-	-	-	-	-	-	-	-	-	-

*Dats were collected since 1993.



AAC/CRDH

Weigela florida 'Nana Purpurea'



AAC/CRDH

Weigela florida 'Nana Purpurea'



AAC/CRDH

Weigela 'Java Red'



AAC/CRDH

Weigela 'Java Red'



AAC/CRDH

Weigela x 'Minuet'



AAC/CRDH

Weigela 'Red Prince'



AAC/CRDH

Weigela 'Red Prince'



AAC/CRDH

Weigela 'Samba'



Jacques-André Rioux

Thuja occidentalis 'Holmstrup'



Jacques-André Rioux

Thuja occidentalis 'Holmstrup'



Jacques-André Rioux

Thuja occidentalis 'Lutescens'



Jacques-André Rioux

Thuja occidentalis 'Lutescens'



AAC/CRDH

Thuja occidentalis 'Mastersii'



Jacques-André Rioux

Thuja occidentalis 'Mastersii'



AAC/CRDH

Tilia japonica (Miq.) Simonkai



AAC/CRDH

Ulmus rubra Muhlenb.



AAC/CRDH

Ulmus rubra Muhlenb.



Serge Gagnon

Syringa meyeri 'Palibin'



AAC/CRDH

Syringa meyeri 'Palibin'



AAC/CRDH

Taxus cuspidata Siebold & Zucc.



AAC/CRDH

Tilia cordata Mill.



AAC/CRDH

Tilia cordata 'Greenspire'



Jacques Côté

Tilia x 'Flavescens Glenleven'



Serge Gagnon

Thuja occidentalis 'Cloth of Gold'



AAC/CRDH

Thuja occidentalis 'Globosa Aurea'



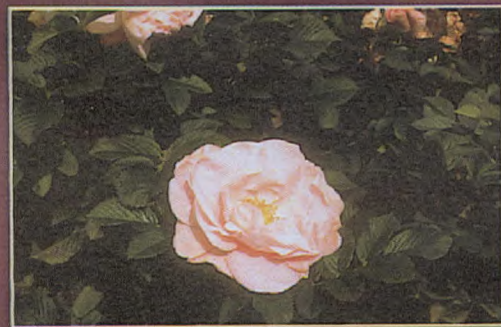
AAC/CRDH

Thuja occidentalis 'Globosa Aurea'



Serge Gagnon

Rosa rugosa 'L'Assomption'



Serge Gagnon

Rosa rugosa 'L'Assomption'



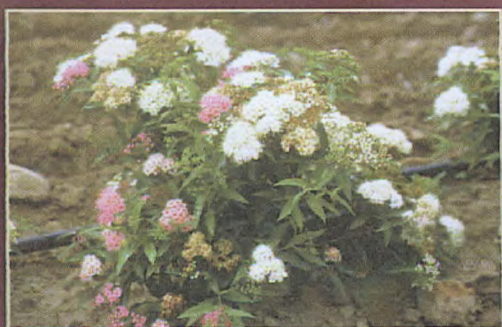
AAC/Normandin

Spiraea japonica 'Flaming Mound'



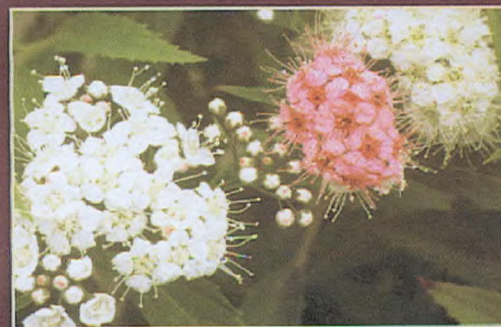
AAC/Normandin

Spiraea japonica 'Flaming Mound'



AAC/CRDH

Spiraea japonica 'Shirobana'



AAC/CRDH

Spiraea japonica 'Shirobana'



AAC/CRDH

Spiraea trichocarpa 'Snow White'



AAC/CRDH

Spiraea trichocarpa 'Snow White'



AAC/CRDH

Rosa 'John Davis'



AAC/CRDH

Rosa 'John Davis'



AAC/CRDH

Rosa 'J.P. Connell'



AAC/CRDH

Rosa 'J.P. Connell'



AAC/CRDH

Rosa 'Louis Jolliet'



AAC/CRDH

Rosa 'Louis Jolliet'



AAC/CRDH

Rosa pimpinellifolia var. *Frühlingsduft*



AAC/CRDH

Rosa pimpinellifolia var. *Frühlingsduft*



AAC/CRDH

Prunus besseyi 'L.H. Bailey'



Jacques Allard

Rhododendron canadense (L.) Torr.



Jacques Allard

Rhododendron canadense (L.) Torr.



AAC/CRDH

Rhododendron molle (Blume) G. Don.



AAC/CRDH

Rhododendron molle (Blume) G. Don.



Jacques Allard

Rhododendron 'Ramapo'



Jacques Allard

Rhododendron 'Ramapo'



Jacques Allard

Rhododendron vaseyi A. Gray.



Jacques-André Rioux

Rhododendron vaseyi A. Gray.



AAC/CRDH

Philadelphus coronarius 'Aureus'



AAC/CRDH

Picea abies 'Nidiformis'



Jacques Allard

Pinus aristata Engelm.



Jacques Allard

Pinus aristata Engelm.



AAC/CRDH

Populus x canescens 'Tower'



Jacques Côté

Potentilla fruticosa 'Goldstar'



AAC/Normandin

Potentilla fruticosa 'McKay's White'



AAC/CRDH

Prunus besseyi 'L.H. Bailey'



AAC/CRDH

Juniperus sabina 'Blue Danube'



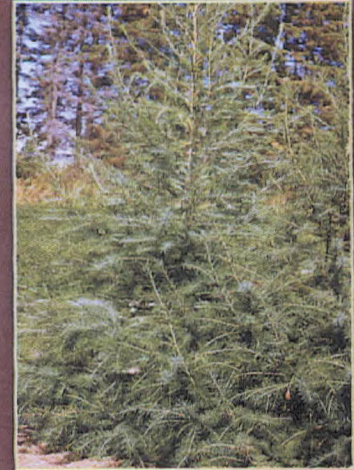
AAC/CRDH

Juniperus sabina 'Broadmoor'



AAC/CRDH

Juniperus scopulorum 'Blue Haven'



AAC/Normandin

Larix kaempferi (Lamb.) Carr.



AAC/Normandin

Larix kaempferi (Lamb.) Carr.



AAC/CRDH

Ligustrum vicaryi Rehd.



AAC/CRDH

Lonicera webbiana Wall.



AAC/CRDH

Philadelphus coronarius 'Aureus'



AAC/CRDH

Gleditsia triacanthos inermis (L.) Zabel.



AAC/CRDH

Gleditsia triacanthos inermis (L.) Zabel.



Jacques Allard

Hydrangea quercifolia Bartr.



Jacques Allard

Hydrangea quercifolia Bartr.



AAC/CRDH

Ilex x meservae 'Blue Prince'



AAC/CRDH

Ilex x meservae 'Blue Princess'



AAC/CRDH

Juniperus communis 'Rependa'



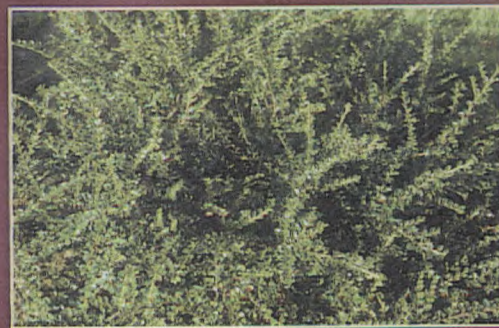
Jacques-André Rioux

Juniperus sabina 'Blue Danube'



AAC/Normandin

Cotoneaster acutifolius Turcz.



AAC/CRDH

Cotoneaster horizontalis Decne.



AAC/Normandin

Crataegus basilica



AAC/Normandin

Crataegus coccinea L.



AAC/Normandin

Crataegus crus-galli L.



AAC/Normandin

Crataegus submollis Sarg.



AAC/CRDH

Daphne cneorum Pall.



AAC/CRDH

Daphne cneorum Pall.



Jacques-André Ploux

Forsythia x ovata 'Happy Centennial'



AAC/Normandin

Betula tianschanica Rupr.



AAC/CRDH

Buxus microphylla 'Green Gem'



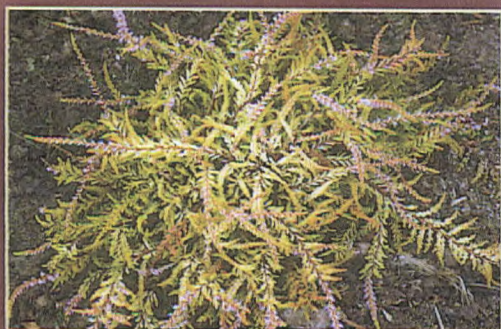
AAC/CRDH

Buxus microphylla 'Green Mound'



Jacques Côté

Buxus microphylla 'Green Mountain'



Jacques Côté

Calluna vulgaris 'Golden Carpet'



Jacques Allard

Cercidiphyllum japonicum
Siebold & Zucc. ex J. Hoffm. & H. Schult.



AAC/CRDH

Chamaecyparis lawsoniana (Murr.) Parl.



AAC/Normandin

Cotoneaster acutifolius Turcz.



Jacques-André Rioux

Abies concolor (Gord.) Lindl. ex Hildebr.



AAC/CRDH

Abies concolor (Gord.) Lindl. ex Hildebr.



Jacques Côté

Acer spicatum Lam.



AAC/CRDH

Aesculus hippocastanum L.



AAC/CRDH

Aesculus hippocastanum L.



AAC/CRDH

Amorpha fruticosa L.



AAC/CRDH

Amorpha fruticosa L.



AAC/Normandin

Aronia arbutifolia (L.) Pers.

HYDRANGEA QUERCIFOLIA BARTR.

Family:	Saxifragaceae
English name:	Oakleaf Hydrangea
French name:	Hydrangée à feuilles de chêne
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub with its irregular, rounded growth habit can reach 1.25 m tall and about 0.90 m wide under the most favourable conditions in Quebec.

The upright young branches, which radiate out from the base, tend to become more spreading with age. Young twigs are covered with a reddish down at the start of the season.

The large leaves, 8-20 cm long, are oval and opposite and resemble those of oak. They are truncated at the base of the blade and divided into three to five lobes. Their margins are finely serrate. The leaves, dull green above and slightly shiny and greyish beneath, turn an orange-brown and purple colour in the fall. They unfold in late spring.

The upright panicles, 10-25 cm long, bear white, slightly fragrant flowers. The small, sterile flowers turn purple in autumn and the fertile flowers are very numerous. Flowering lasts from July until the first killing frost of fall.

The roots are numerous and tend to develop suckers.

ORIGIN AND DISTRIBUTION

This hydrangea is native to the southwestern United States and was discovered in 1803. It has been marketed in North America since 1928.

USE

Ornamental: This species is a good choice for rock gardens and other gardens, either as a specimen plant or as part of a grouping.

REQUIREMENTS

Like other hydrangeas, this species prefers sunny exposures, but it can adapt to partial shade. Although it will thrive in several soil types, it requires cool, well-drained, rich soils.

The plant recovers well after transplanting.

DISEASES AND INSECTS

To our knowledge, this species is not affected by insect pests. However, powdery mildew, caused by *Microsphaera polonica*, often damages the foliage of hydrangeas during wet, hot summers.

PROPAGATION

Cuttings: All the hydrangeas can be propagated from cuttings by placing terminal shoot sections in controlled humidity and heat conditions. The cuttings are taken in summer from semiripe shoots. Cuttings of buds with leaves give good results for most of the hydrangeas.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: 240 cuttings (15 cm) were taken on July 18, 1990 from three-year-old parent plants. They were dipped for five seconds in a 4,000-ppm IBA/50 % ethanol solution, then planted in plug trays filled with Promix® and perlite (1:1; v:v) and placed under a mist unit operating 30 seconds every 7 minutes. The rooting rate was 53 %. On August 22, they were placed in outdoor cold

frames to overwinter. The winter survival rate was 100 %. The seedlings were wrapped on May 3, 1991 to await shipping a few days later.

Inclusion in testing network: Seedlings (10-15 cm high) were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

At all the sites, 10-25 % of the shrubs died after transplanting. A large number of plants died during the trial and all of the plants suffered damage every winter.

Region 1

At L'Assomption, two seedlings survived the test. The first three winters, 33 %, 56 % and 33 % of the shrubs died. All of the other plants froze at different levels each winter. The first winter, all the seedlings were found to have frost damage right down to the snow cover, and this type of damage was observed in 11 % and 50 % of the shrubs during the second and last winters. Damage to the branch tips was recorded in 22 %, 67 % and 99 % of the surviving shrubs during the second, third and fourth winters.

At Sainte-Clotilde, all of the seedlings died the first winter.

At Saint-Hyacinthe, 72 % of the seedlings died the first winter and the surviving ones died the following winter. In addition, all of the ones that survived the first winter had frost damage to the entire aerial portion.

Region 2

At Deschambault, 22 % and 55 % of the seedlings died during the first two winters. In addition, 57 %, 45 % and

60 % of the plants suffered frost damage to the shoots above the ground level the first three winters. The other shrubs had damage to the previous year's shoots. The fourth winter, all of the shrubs had damaged branch tips. Four out of five plants were damaged by rodents the last winter.

At Sainte-Foy, 79 % and 33 % of the shrubs died the first two winters; the others suffered frost damage to the old wood the first winter and damage to shoots extending down to the snow cover the second winter. Only one plant survived the last three years; it showed frost damage to the old wood, rodent damage and damage to the previous year's shoots successively.

At La Pocatière, 54 %, 33 % and 25 % of the plants died over the first three winters. Nearly all of the survivors suffered frost damage to the aerial portion above the snow cover or the ground level, except during the fourth winter when the only damage observed was frost damage to branch tips.

Region 3

At Normandin, all of the seedlings died during the first two winters, whereas at Kapuskasing, all of them died the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

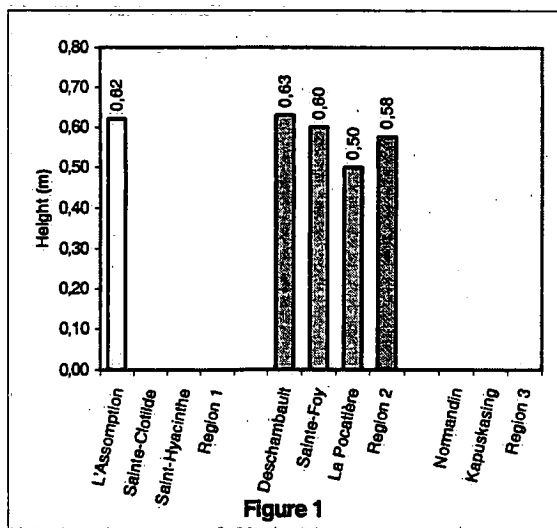


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

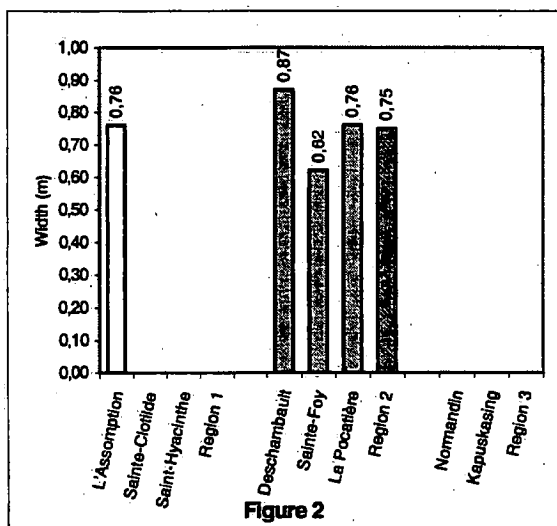


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

The shrubs were cut back by removing more than 50 % of their height at all sites each year.

Flowering

Flowering lasted 50-85 days depending on the year and the site. In the present trial, the severe pruning required at most sites as a result of frost damage to branches reduced

the plants' ability to flower. On plants that did flower, blooms appeared between July 10 and 25, and flowering ended with the arrival of autumn frosts.

PRODUCTION RECOMMENDATIONS

Cultivation of this hydrangea is limited by the severity of the winter damage that occurs, and this applies to all of the hardiness zones included in the trial. This species is therefore not recommended for production in Quebec.

HARDINESS EVALUATION

Most of the plants died during the evaluation period. Although this species is considered hardy to zone 5b in the literature, the test results show that it has a very low potential for survival in Quebec and that it can only survive in warmer zones than those tested.

The shrub can only be used and attain full ornamental potential outside the zones tested.

Collectors located in hardiness zone 4, where considerable snow cover can build up, are the only operators who can successfully grow specimens: however, the plants need protection during the cold periods of the fall, winter and spring. The risk of frost damage and mortality is very high during the first few years after planting. Indeed, the plants that survived the first three winters showed slight growth subsequently as well as some flowering.

BIBLIOGRAPHIC REFERENCES

2, 7, 8, 31, 33, 39, 67

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Hydrangea quercifolia* Bartr. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	0				5		90		5		100
Sainte-Clotilde	0						100				100
Saint-Hyacinthe*	0						100				100
REGION 2											
Deschambault	0	28	11			33	15			13	100
Sainte-Foy	0		2	2			95			1	100
La Pocatière	0	18	3		33	16	23		7		100
REGION 3											
Normandin	0						100				100
Kapuskasing	0						100				100

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period.

No damage of type 3 and 9 occurred for this species.

ILEX X MESERVAE

'BLUE PRINCE'

Family:	Aquifoliaceae
English name:	Blue Prince Holly
French name:	Houx hybride 'Blue Prince'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small shrub can grow to 1.2 m high and 1.0 m wide under Quebec conditions, compared with a height of 4.0 m in the United States. Its upright, compact habit gives it a pyramidal shape.

The stems are blue-purple in colour, hence the cultivar's name.

The dark green leaves are alternate and persistent. Truncated, pointy and shiny, they have beautiful bluish highlights in summer and take on a bronze cast during the winter.

The species is dioecious, and this cultivar bears only male flowers. These small, solitary flowers produce abundant pollen; they persist through much of the summer but have little ornamental value.

The root system is shallow and not very developed.

ORIGIN AND DISTRIBUTION

This US holly cultivar was derived from a cross between *I. rugosa* and *I. aquifolium* performed in 1946 by Kathleen Meserve of New York, who was seeking to obtain a plant better adapted to the eastern part of North America. The cultivar was put on the market in 1975 along with *Ilex x meservae* 'Blue Princess'.

USE

Ornamental: This shrub's evergreen foliage makes it attractive all year round. It is used primarily in rock gardens and in mass plantings. It is slower growing than the cultivar that bears female flowers.

REQUIREMENTS

The plant will tolerate full sun, but prefers partial shade. It requires a rich, slightly acidic and moist soil. Although this is a hardy shrub, frost injury often occurs to the branch portions above the snow cover. In some regions with limited snow cover, winter protection is recommended. A site sheltered from the winds will allow better growth. This male cultivar must be present to pollinate and induce fruit set in female *Ilex*.

DISEASES AND INSECTS

Spittlebugs are the only insect pests of *Ilex* mentioned in the Réseau d'avertissements phytosanitaires.

PROPAGATION

Cuttings: Semiripe cuttings taken in summer appear to be the most effective propagation method. When the cuttings are treated with a solution containing an auxin hormone, rooting generally exceeds 80 %.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (3-4 cm long) were taken on July 26, 1990 from parent plants roughly 10 years old and measuring about 50 cm tall and 100 cm wide. The cuttings were dipped for 5 seconds in a 5,000-ppm IBA/50 % ethanol solution, planted in plug trays filled with a sand-perlite mixture (2:1; v:v) and placed under a mist

unit operating 8 seconds every 32 minutes. A Benomyl® fungicide treatment was applied weekly throughout the propagation period. The rooting rate was 85 % after 5 weeks. The plants were treated with a 10-52-10 fertilizer at the recommended rate. The plants were placed in a greenhouse with 16 hours of light per day until spring 1991 and treated weekly with a soluble fertilizer (20-20-20). On May 23, 264 plants were transplanted to the nursery. On October 15, they were dug up, puddled, heeled in and then given winter protection (cover). The winter survival rate was 100 %. In May 1992, the plants were wrapped and stored in the cellar to await shipping.

Inclusion in testing network: Seedlings 6-10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one plant died the second winter and two died the fourth winter. Frost injury to the branch tips was observed in 50 % of the seedlings the first winter. Over the following two winters, nearly all the plants showed partial browning of their foliage. The fourth winter, all the shrubs suffered frost damage down to the snow cover and the last winter they all had rodent damage.

At Sainte-Clotilde, 14 plants died the first winter and two additional ones the third and fourth winters. Frost damage to the branch tips and flower buds was observed in 20 % and 5 % of the seedlings the first winter. The last three

winters, 83 %, 60 % and 50 % of the shrubs exhibited partial browning of their foliage.

At Saint-Hyacinthe, 13 seedlings died the first winter and three others died the following winter. The four remaining shrubs suffered frost damage to the branch tips in the second, third and fourth winters. After that, partial browning of foliage was noted in three shrubs.

Region 2

Two plants died the first winter at Sainte-Foy and all the others had frost damage extending down to the snow cover. Frost damage to the branch tips was observed over the following three winters in 68 %, 42 % and 58 % of the plants. In addition, one shrub showed frost damage to the previous year's shoots the third winter.

At Deschambault, no mortality occurred during the trial. All the plants suffered frost damage right down to the snow cover the second winter. Frost damage to the branch tips was observed in 40 %, 67 %, 100 % and 33 % of the shrubs the first and third winters.

At La Pocatière, 9 %, 10 % and 18 % of the plants had frost damage to the branch tips the last three winters.

Region 3

At Normandin, three plants died after transplanting, eight died the first winter and one shrub died the fifth winter. Frost damage extending down to the snow cover occurred in 33 % of the plants the first winter. Subsequently, 20 % of the plants suffered frost damage to the branch tips the second winter and 38 % showed foliage browning the fourth winter.

At Kapuskasing, eight plants died during the trial. The previous year's shoots were damaged the first, third and fourth winters in 5 %, 54 % and 13 % of the shrubs. Frost injury extending to the ground level occurred in the second, third and fourth winters in 6 %, 18 % and 13 % of the plants.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

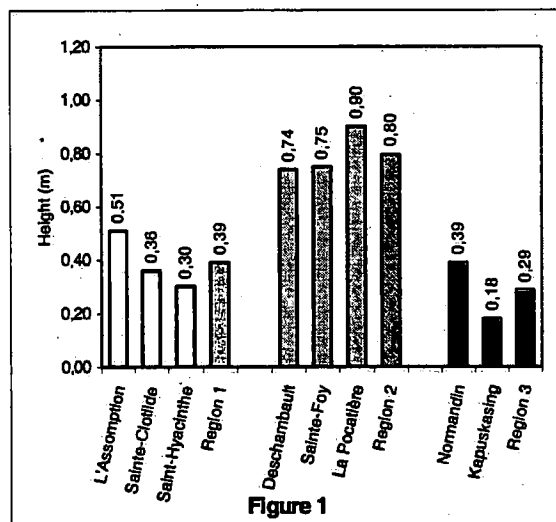


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

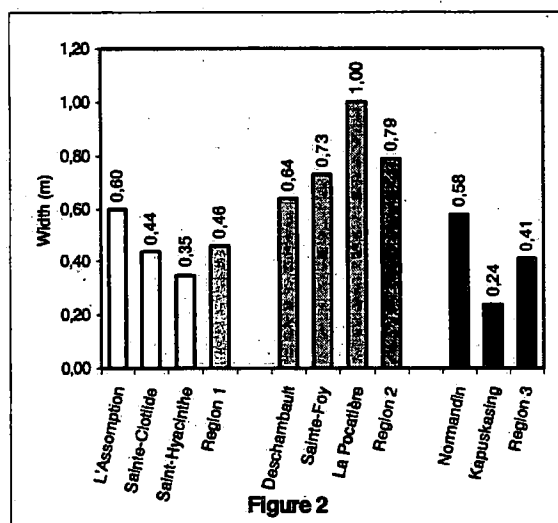


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

The height values were particularly high within region 2.

The widths were highly variable within each of the regions. All of the plants were wider than tall as of the first year.

Effect of pruning

Pruning severity varied greatly within the different regions, and involved reducing plant height by 0-40 %. Annual growth was cut back by about 70 % after the first winter at Sainte-Foy and after the second winter at Deschambault.

Flowering

This cultivar did not produce flowers in region 1, except on four shrubs at Saint-Hyacinthe the last year. The only data available are for the end of flowering (May 30). In region 2, flowering began between May 30 and June 12 and ended 5 to 11 days later. At Normandin, a few plants flowered between June 5 and 11 and flowering lasted 8 to 18 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Recovery from transplanting was excellent, even though bareroot stock is recommended for transplanting purposes.

The fastest growth was recorded at L'Assomption and La Pocatière during the first two years, with 80 % of the hollies attaining a height of 41-80 cm. Only Sainte-Foy produced plants of comparable height over the following years. Production of this cultivar is recommended in areas that have good snow cover (north shore of zone 5 or in zone 4).

HARDINESS EVALUATION

This cultivar gave complex results. Winter survival is closely tied to the snow cover and the harshness of climatic conditions. A number of plants died in region 1 (zone 5) because of insufficient protection and in region 3 (zone 2)

because of the cold temperatures. The shrubs also frequently exhibited foliage browning and frost damage down to the snow cover, with these two types of damage occurring in comparable proportions in regions 1 and 2. In addition, the plants at region 3 sites had less severe injuries, but they did not grow taller than 20 cm during the trial.

This hybrid can survive at sites with snow cover that is laid down early and that lasts throughout the freezing period. This requirement makes it less useful for sites in zones 5 and 2.

Full ornamental potential was not achieved and can only be attained in hardiness zones warmer than those tested.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 17, 18, 28, 31

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Ilex x meserveae* 'Blue Prince' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	6	7	8	10	11	14	
REGION 1											
L'Assomption	13	10			17		5		20	35	87
Sainte-Clotilde	31	4	1	4			21			39	69
Saint-Hyacinthe	0	54			4		22	5		15	100
REGION 2											
Deschambault	26	48		1	20		1	3		1	74
Sainte-Foy	44	34		2	18		2				56
La Pocatière	63	7			30						37
REGION 3											
Normandin	69	5			6		13			7	31
Kapuskasing	38	24		14		7	14			3	62

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 5 and 9 occurred for this cultivar.

Table 2. Breakdown of *Ilex x meserveae* 'Blue Prince' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	5	5	0	0	0	24	67	34	20	0	25	80	50	0	0
021-040	81	14	0	0	0	71	33	50	80	75	60	20	50	100	100
041-060	14	76	82	100	78	5	0	16	0	0	15	0	0	0	0
061-080	0	5	18	0	22	0	0	0	0	25	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	15	0	0	0	0	5	11	0	0	0	33	5	0	0	0
021-040	75	50	92	0	0	66	89	33	0	0	67	19	0	0	0
041-060	10	50	8	100	0	29	0	67	0	0	0	66	67	9	0
061-080	0	0	0	0	83	0	0	0	92	75	0	10	33	82	0
081-100	0	0	0	0	17	0	0	0	8	25	0	0	0	9	100
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	44	20	12	13	0	42	44	27	63	71					
021-040	56	40	88	50	86	58	56	63	37	29					
041-060	0	40	0	37	14	0	0	10	0	0					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Ilex x meseroae* 'Blue Prince' plants by marketable width category from 1992 to 1996

REGION 1															
Width	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
(cm)	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	62	10	0	0	0	86	86	33	25	0	100	80	50	75	0
021-040	38	81	64	9	0	14	14	50	75	100	0	20	50	25	100
041-060	0	9	36	82	44	0	0	17	0	0	-	-	-	-	-
061-080	0	0	0	9	56	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width	Deschambault					Sainte-Foy					La Pocatière				
(cm)	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	45	0	0	0	0	24	16	0	0	0	76	5	0	0	0
021-040	55	70	100	8	0	76	79	25	0	0	24	48	0	0	0
041-060	0	30	0	92	23	0	5	75	8	0	0	42	50	0	0
061-080	0	0	0	0	67	0	0	0	50	75	0	5	50	64	0
081-100	-	-	-	-	-	0	0	0	42	25	0	0	0	36	64
101-120	-	-	-	-	-	-	-	-	-	-	0	0	0	0	36
REGION 3															
Width	Normandin					Kapuskasing									
(cm)	92	93	94	95	96	92	93	94	95	96					
001-020	83	40	13	13	0	95	81	36	50	43					
021-040	17	60	62	12	0	5	19	64	50	57					
041-060	0	0	25	62	57	-	-	-	-	-					
061-080	0	0	0	13	43	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

ILEX X MESERVAE

'BLUE PRINCESS'

Family:	Aquifoliaceae
English name:	Blue Princess Holly
French name:	Houx hybride 'Blue Princess'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small shrub can reach a height of 1.0 m and a width of 0.6 m under Quebec conditions; however, in the United States it can reach a height of 5.0 m and a spread of 2.0 m. Its erect habit and pyramidal shape give it considerable volume.

The stems are blue-purple in colour, hence the cultivar's name. They are somewhat thorny.

The dark green leaves are alternate and persistent. Truncated, pointy and shiny, the leaves have a bluish cast in summer and turn a bronze colour in the winter.

The species is dioecious, and this female cultivar produces flowers and many berries, which turn red in autumn and persist into winter. The white flowers, though abundant, have little ornamental value.

The root system is shallow and not very developed.

ORIGIN AND DISTRIBUTION

This US holly cultivar was derived from a cross between *I. rugosa* and *I. aquifolium* performed in 1946 by Kathleen Meserve of New York, who was seeking to obtain a plant better adapted to the eastern part of North America. This cultivar was put on the market in 1975 concurrently with *Ilex x meservae* 'Blue Prince'.

USE

Ornamental: This shrub's evergreen foliage and persistent fruits make it attractive all year round. It is primarily used in rock gardens and in mass plantings. It is faster growing than the male cultivar.

REQUIREMENTS

The plant will tolerate full sun but prefers partial shade. It requires a rich, slightly acidic and moist soil. Although this is a hardy shrub, frost injury often occurs to the branch portions above the snow cover. In some regions with limited snow cover, winter protection is recommended. A site sheltered from the winds will allow better growth. A male plant is required to pollinate this female cultivar and ensure a good fruit set.

DISEASES AND INSECTS

Spittlebugs are the only insect pests of *Ilex* that are mentioned in the Réseau d'avertissements phytosanitaires.

PROPAGATION

Cuttings: Semiripe cuttings taken in summer appear to be the most effective propagation method. When the cuttings are treated with a solution containing an auxin hormone, rooting generally exceeds 50 %.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of the parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (6 cm long) were taken on July 26, 1990 from parent plants roughly 10 years old and about 50 cm high and 90 cm wide. The cuttings were dipped for 5 seconds in a 5,000-ppm IBA/50 % ethanol solution, then planted in plug trays filled with sand and perlite (2:1; v:v) and placed under mist unit

operating 8 seconds every 32 minutes. A Benomyl® fungicide treatment was applied weekly throughout the propagation period. The rooting rate was 61 % after 5 weeks. The plants were treated with a 10-52-10 fertilizer at the recommended rate. The plants were placed in a greenhouse with 16 hours of light per day until spring 1991 and treated weekly with a soluble fertilizer (20-20-20). On May 23, 264 plants were transplanted to the nursery. On October 15, they were dug up, puddled, heeled in and then given winter protection (cover). The winter survival rate was 100 %. In May 1992, the plants were wrapped and stored in the cellar to await shipping.

Inclusion in testing network: Seedlings 20 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

A few plants died after transplanting : one at each of the L'Assomption and Saint-Hyacinthe sites and three at Normandin.

Region 1

At L'Assomption, 20 % of the shrubs died the first winter and 10 % the third winter. Foliage browning was observed during the following two winters in 65 % and 90 % of the plants. The fourth winter, all the shrubs exhibited frost damage right down to the snow cover. Subsequently, frost damage to the branch tips and rodent damage were recorded in equal proportions.

At Sainte-Clotilde, reports of damage were highly variable during the first winter : frost damage to the branch tips,

the flower buds, the previous year's shoots and right down to the snow cover was observed in 23 %, 8 %, 30 % and 31 % of the plants. The following year, one plant suffered only light damage. The foliage of all plants was affected during the third and final winters. The previous year's shoots were damaged in 66 % of the shrubs during the fourth winter.

At Saint-Hyacinthe, 5 % and 30 % of the plants died the first and fourth winters. Frost damage to the branch tips occurred during the first four winters in 20 %, 100 %, 76 % and 24 % of the shrubs. Various other types of damage occurred : frost damage to the previous year's shoots in 12 % of shrubs the fourth winter, frost injury to branches above the snow cover in 55 % of shrubs the first winter and foliage browning in 24 % and 60 % of plants during the third and fourth winters.

Region 2

During the first winter at Sainte-Foy, all the plants suffered frost damage right down to the snow cover. The following winter, 90 % of the plants exhibited frost damage to the branch tips. No further damage was observed subsequently.

At Deschambault, various types of damage occurred the first winter : frost injury to the foliage, the branch tips, the previous year's shoots and frost injury right down to the ground level were observed in 19 %, 24 %, 14 and 5 % of the plants. The following year, all the plants showed frost damage right down to the snow cover. The branch tips were affected in 33 %, 75 % and 25 % of the shrubs the last three winters. Foliage browning was noted in 25 % of the shrubs in the third winter.

At La Pocatière, frost damage down to the snow cover was observed during the first three winters in 14 %, 76 % and 27 % of the plants, and 9 % of them had frost injury to the branch tips in the fourth winter.

Region 3

At Normandin, each winter 60-100 % of the plants showed no damage. Branch tips were affected in 39 % and 33 % of the shrubs the first two winters and foliage browning was also seen the fourth winter.

At Kapuskasing, five plants died during the last three winters. Frost injury to branch tips was recorded each winter in 10 %, 5 %, 25 %, 70 % and 13 % of the shrubs. Nearly 10 % of the plants were affected by foliage browning the first and third winters. In addition, during the third winter, half of the shrubs showed frost injury to the previous year's shoots.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

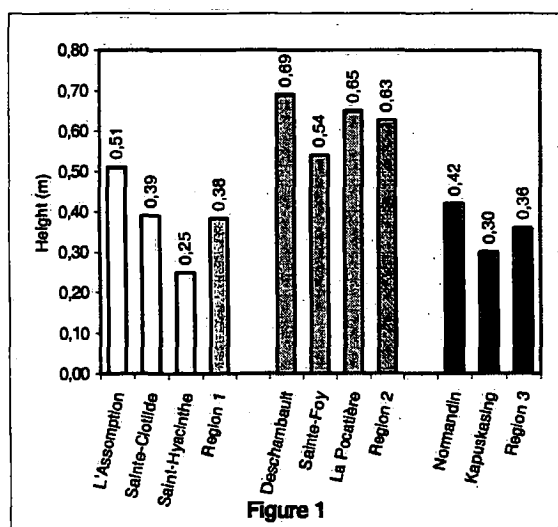


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

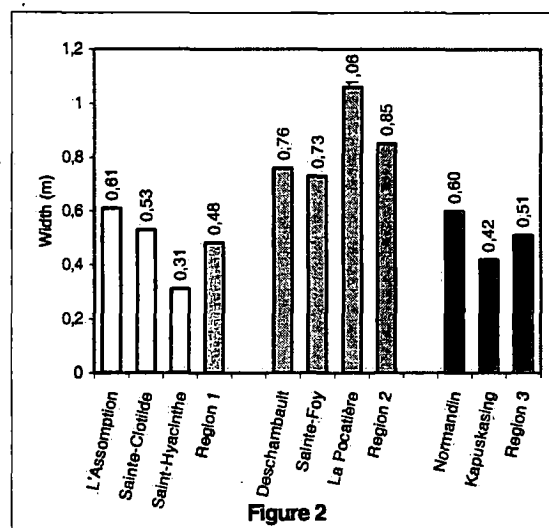


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

The height values were particularly high in region 2. Slow to no growth sequences were observed at all region 1 and 3 sites.

Width exceeded height as of the third year in regions 2 and 3 and as of the fourth year in region 1. The plants of this cultivar are slightly wider than tall.

Effect of pruning

For the most part, only light pruning was done. However, more severe pruning was done during the first two years at Sainte-Foy and Deschambault.

Flowering

Only some incomplete data are available for the L'Assomption and Saint-Hyacinthe sites in region 1. In region 2, however, flowering occurred between May 28 and June 5, lasting 7-10 days. No flowering occurred in region 3.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these

tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Recovery from transplanting was excellent, although bareroot stock is recommended for transplanting purposes.

Growth was faster at L'Assomption and La Pocatière during the first two years, with 80 % of the hollies reaching a height of 41-80 cm. Only Sainte-Foy produced plants of comparable height over the following years. Production of this cultivar is recommended in areas that have good snow cover (north shore of zone 5 or in zone 4).

HARDINESS EVALUATION

This cultivar gave complex results. Winter survival is closely tied to the snow cover and the harshness of climatic conditions. A number of plants died in region 1 (zone 5) because of insufficient protection and in region 3 (zone 2) because of the cold temperatures. The shrubs also frequently exhibited foliage browning and frost damage down to the snow cover, with these two types of damage occurring in comparable proportions in regions 1 and 2. In addition, the plants at region 3 sites had less severe damage, but they did not grow taller than 20 cm during the trial.

This hybrid can survive at sites with snow cover that is laid down early and that lasts throughout the freezing period. This requirement makes it less useful for sites in zones 5 and 2.

This cultivar seems a little less fragile than 'Blue Prince' does. Furthermore, in zones 4 and 5a, this plant can produce a good fruit set provided the branches do not suffer frost injury.

Full ornamental potential was not achieved and can only be attained in hardiness zones warmer than those tested.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 27, 31

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Ilex x meseroae* 'Blue Princess' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	6	7	8	10	11	14	
REGION 1											
L'Assomption	24	8			20		7		11	30	76
Sainte-Clotilde	27	6	2	19	6					40	73
Saint-Hyacinthe	17	44		2	11		11			15	83
REGION 2											
Deschambault	34	32		3	20	1		2		8	66
Sainte-Foy	62	18			20						38
La Pocatière	67	1			24		1	7			33
REGION 3											
Normandin	77	12					3			8	23
Kapuskasing	48	24		10			10	6		2	52

- ^aKey:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 5 and 9 occurred for this cultivar.

Table 2. Breakdown of *Ilex x meserveae* 'Blue Princess' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	15	0	0	0	0	0	5	0	0	0	15	68	69	38	10
021-040	85	25	30	33	0	90	95	67	75	75	70	32	31	62	90
041-060	0	75	70	67	100	10	0	33	25	25	15	0	0	0	0
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	0	5	0	0	0	19	5	0	0	0	33	5	0	0	0
021-040	95	71	100	8	0	67	95	67	0	0	62	0	0	0	0
041-060	5	19	0	63	33	14	0	33	67	92	5	90	42	64	36
061-080	0	5	0	9	50	0	0	0	33	8	0	5	58	36	64
081-100	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	22	11	17	0	0	19	10	0	20	0					
021-040	78	66	67	41	67	76	90	100	80	100					
041-060	0	23	16	59	33	5	0	0	0	0					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Ilex x meseroae* 'Blue Princess' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	45	0	0	0	0	75	20	0	0	0	100	74	54	15	30
021-040	55	50	40	11	0	25	80	58	67	32	0	26	46	85	50
041-060	0	50	60	56	56	0	0	42	25	43	0	0	0	0	20
061-080	0	0	0	33	44	0	0	0	8	25	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
121-140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	24	5	0	0	0	24	5	0	0	0	76	0	0	0	0
021-040	76	52	33	0	0	76	66	8	0	0	24	10	0	0	0
041-060	0	43	50	58	8	0	29	92	0	0	0	85	8	0	0
061-080	0	0	17	42	50	0	0	0	75	84	0	5	67	45	0
081-100	0	0	0	0	42	0	0	0	25	16	0	0	25	28	27
101-120	-	-	-	-	-	-	-	-	-	-	0	0	0	27	55
121-140	-	-	-	-	-	-	-	-	-	-	0	0	0	0	18
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	61	22	8	0	0	57	10	0	0	0					
021-040	39	67	75	0	0	43	90	75	80	37					
041-060	0	11	17	75	50	0	0	25	20	63					
061-080	0	0	0	25	50	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					
121-140	-	-	-	-	-	-	-	-	-	-					

JUNIPERUS COMMUNIS

'REPENDA'

Family:	Cupressaceae
English name:	Repanda Juniper
French name:	Genévrier commun rampant
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This low, spreading shrub with a rounded crown rarely grows taller than 0.5 m, but may sometimes have a spread greater than 3.0 m. It forms a dense carpet on the ground.

The horizontal branches with their slightly upturned tips bear many twigs with reddish bark. The erect, filiform-shaped young shoots grow in various directions.

The stems form small suckers.

The bark, often thin and fibrous, becomes scaly with age and often strips off in papery sheets.

Young leaves are cupressoid leaves, becoming squamiform at maturity. The leaves are opposite and covered with stomatic bands. They bear soft, non-prickly, overlapping scales. The needles are shiny, light green above and whitish green beneath.

The shrub is shallow rooting.

ORIGIN AND DISTRIBUTION

This cultivar resulted from natural selection, but none of the references consulted give the year of introduction.

USE

Ornamental: This ground-cover shrub is used in rock gardens and mass plantings.

REQUIREMENTS

Like most junipers, this cultivar requires a sunny exposure. It adapts to all soil types, provided they are rich in organic matter and well drained.

It has good cold hardiness when there is plenty of snow cover. During harsh winters, needle browning or frozen branch tips may occur.

Pruning is only needed if the goal is to limit the shrub's development.

DISEASES AND INSECTS

Phomopsis blight (*Phomopsis juniperovora*) attacks most junipers. However, the cultivars and varieties derived from *Juniperus communis* are among the most resistant.

Cedar rusts (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases requiring a primary host to begin their life cycle. All junipers may act as primary hosts, with *Juniperus communis* and its cultivars and varieties being among the most susceptible. *Alternaria* and *Epicoccum* are other fungal diseases that may also cause serious damage.

The insects that attack junipers include scale insects (Fletcher scale), mites and spittlebugs.

PROPAGATION

Cuttings: This method is effective when shoots with a heel are used. Whereas most cultivars of *J. communis* are difficult to work with because of their sharp, prickly needles, the 'Rependa' cultivar, with its soft needles, is easy to manipulate. The period recommended for taking cuttings runs from late July to late August. A higher success rate can be obtained with a rooting hormone and a sand-peat substrate.

Layering: When working with small quantities, flat layering is a very good approach for creeping species. The

cut twigs are kept flat in a sand-peat substrate until rooting occurs.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 436 cuttings (12 cm) were taken on May 23, 1990 from parent plants about 4 years old. They were dipped for 5 seconds in a 8,000-ppm IBA/50 % ethanol solution and rinsed with tap water. The cuttings were then immersed in a Benomyl-Captan® fungicide solution, planted in a peat-perlite medium (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 35 % after 78 days. On August 8, the seedlings were potted up in Fertil Pots® using a peat-perlite medium (3:2; v:v) and placed in a tunnel greenhouse. In November, they were placed in the cold store at 0 °C in plastic bags that had been perforated with a hatpin. In May 1991, the plants were placed in a tunnel greenhouse for about a month and then put outside in lightly shaded cold frames. They were treated weekly with a soluble fertilizer (20-20-20, 200 ppm nitrogen) until mid-September. In November, they were put back in the cold store at 0 °C. In early May 1992, they were wrapped and returned to the cold store at 4 °C to await shipping a few days later.

Inclusion in testing network: Young seedlings 13 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 6 %, 9 % and 10 % of the plants died the second, fourth and fifth winters. Foliage browning was noted in all seedlings the first winter. During the last winter, 40 % of the shrubs were damaged by rodents.

No damage occurred at Sainte-Clotilde.

At Saint-Hyacinthe, one shrub died the fourth winter. Frost damage to the branch tips occurred in 33 % of the seedlings the first winter. Foliage browning occurred in 8 %, 8 % and 14 % of the shrubs the second, third and fifth winters.

Region 2

No damage occurred at the Sainte-Foy and La Pocatière sites.

At Deschambault, one seedling showed frost damage to the one-year-old shoots the fourth winter.

Region 3

At Normandin, 11 % of the plants suffered frost damage to the branch tips the second winter.

During the fourth winter, 17 % of the shrubs suffered frost damage to the one-year-old shoots and one shrub died at Kapuskasing.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

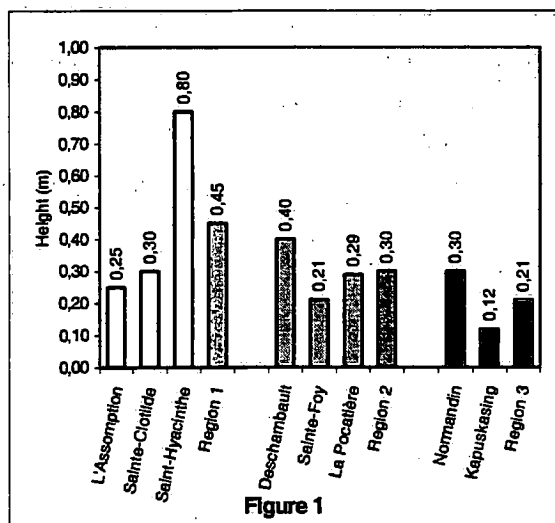


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

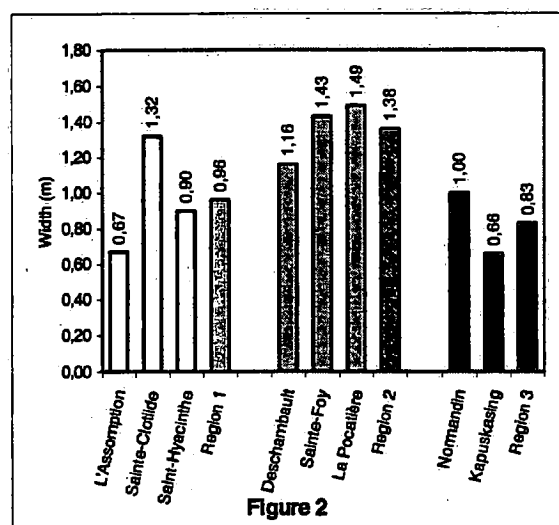


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Width growth was slower at L'Assomption and Kapuskasing.

Effect of pruning

The only pruning done was at Sainte-Foy and Normandin, where the shrubs' spread was cut back by more than a third the last two years.

PRODUCTION RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants obtained at each site after each year by width categories (width are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given width.

Since the plants were of uniform height (less than 50 cm) at the end of the evaluation period, only Table 2 is shown. It indicates the percentage of marketable seedlings obtained at each test site after each year by width category (widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given width.

After two growing seasons, 80-100 % of the shrubs had reached a spread of 41-80 cm at Sainte-Clotilde, Deschambault, Sainte-Foy, La Pocatière and Normandin. It took another year at L'Assomption and another year Kapuskasing to obtain shrubs with a comparable spread.

This cultivar can be produced at all the test sites, but growth is slower in zone 2a, at Kapuskasing.

HARDINESS EVALUATION

According to the literature, this cultivar is hardy to zone 3 or 4a. The test results clearly show that its survival is assured in zone 2a, since 95 % of the shrubs survived there over a period of five years. However, some plants died at the sites in zone 5 over several winters. This mortality can be explained by a lack of snow during the fall or winter. Snow cover ensures the plant's survival, regardless of the hardiness zone.

The shrub can be used as far as zone 2, and full ornamental potential can be attained in zone 4 (abundant snow cover) or 5b.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 9, 18, 28, 33, 35, 39, 73

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Juniperus communis* 'Rependa' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	5	6	7	8	11	14	
1											
REGION 1											
L'Assomption	67							5	8	20	33
Sainte-Clotilde	100										0
Saint-Hyacinthe	86	7						1		6	14
REGION 2											
Deschambault	98									2	2
Sainte-Foy	100										0
La Pocatière	100										0
REGION 3											
Normandin	98	2									2
Kapuskasing	95			3				2			5

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7, 9 and 10 occurred for this cultivar.

Table 2. Breakdown of *Juniperus communis* 'Rependa' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	94	27	0	20	100	12	0	0	0	100	72	67	58	18
041-080	0	6	73	91	50	0	88	50	8	0	0	28	33	17	18
081-120	0	0	0	9	30	0	0	50	92	17	0	0	0	25	27
121-160	-	-	-	-	-	0	0	0	0	83	0	0	0	0	28
161-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	88	6	0	0	0	12	0	0	0	0	100	0	0	0	0
041-080	12	94	100	17	0	88	100	25	0	0	0	100	0	0	0
081-120	0	0	0	83	75	0	0	75	0	0	0	0	100	75	0
121-160	0	0	0	0	25	0	0	0	67	100	0	0	0	25	100
161-200	-	-	-	-	-	0	0	0	33	0	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	17	0	0	0	94	38	33	25	18					
041-080	0	83	67	8	0	6	62	67	75	55					
081-120	0	0	33	92	100	0	0	0	0	27					
121-160	-	-	-	-	-	-	-	-	-	-					
161-200	-	-	-	-	-	-	-	-	-	-					

JUNIPERUS SABINA

'BLUE DANUBE' (CONTROL 1991)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Diseases and Insects and Bibliographic References can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume II (VR.221).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: In November 1988, 500 cuttings (15 cm) were taken from roughly five-year-old parent plants. They were placed in the cold store at -1 °C in plastic bags that had been perforated with a hatpin and filled with snow. In February 1989, they were kept at 4 °C for 24 hours and then prepared. The cuttings were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. After immersion in a fungicide bath (Benomyl-Captan®), they were planted in a peat-perlite substrate (1:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 80 % after 98 days. In early June, the seedlings were potted up in 10-cm pots using a peat-perlite substrate (3:2; v:v). They were treated weekly with a soluble fertilizer (20-20-20) until mid-September and kept in an unheated greenhouse. In mid-November, they were moved to the cold store and held there at 0 °C in plastic bags perforated with a hatpin. In May 1990, 250 seedlings were transplanted to the nursery and grown on until May 1991. They were then dug up, puddled, wrapped and placed in the cold store at 4 °C to await shipping.

Inclusion in testing network: Seedlings 15 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption and Sainte-Clotilde, the mortality rate was high after transplanting, with 71 % and 38 % of seedlings dying. Only one plant did not survive transplanting at Saint-Hyacinthe.

No damage occurred at L'Assomption. In Sainte-Clotilde, one plant died during each of the second and third winters, whereas at Saint-Hyacinthe, three plants died the first year and two additional plants the following winter.

Region 2

Five seedlings died after being planted at Sainte-Foy, two died at Deschambault and more than half of the seedlings succumbed at La Pocatière.

During the first year at Sainte-Foy, three seedlings showed foliage damage but no other damage occurred during the trial.

At Deschambault, one seedling died the first winter and more than a third of the plants had browning damage to the foliage. No further damage was recorded subsequently.

No damage occurred at La Pocatière.

Region 3

Six seedlings died following transplanting at both of the sites.

At Normandin, no damage occurred during the second year and the last two years. One plant died the first winter and another the third winter. Mechanical breakage was also observed on one shrub during the third year.

No damage was recorded during the last three years at Kapuskasing. Three plants suffered frost damage to the branch tips the first winter and one died. The following winter, two shrubs had damage to the one-year-old shoots, one had mechanical damage and another, foliage browning.

Height and width growth

Figures 1 and 2 show the mean height and width of the shrubs after five years at each site in the three regions.

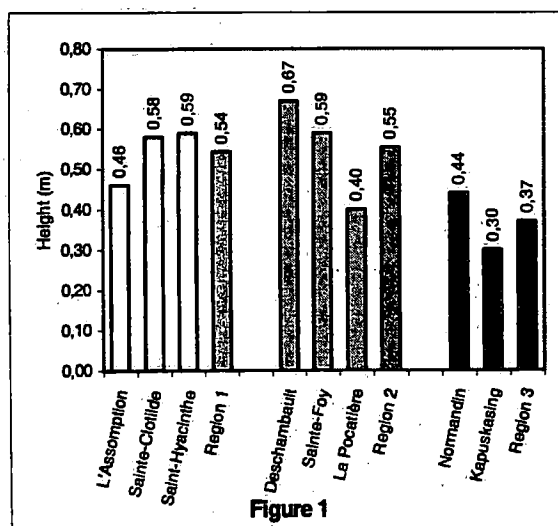


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

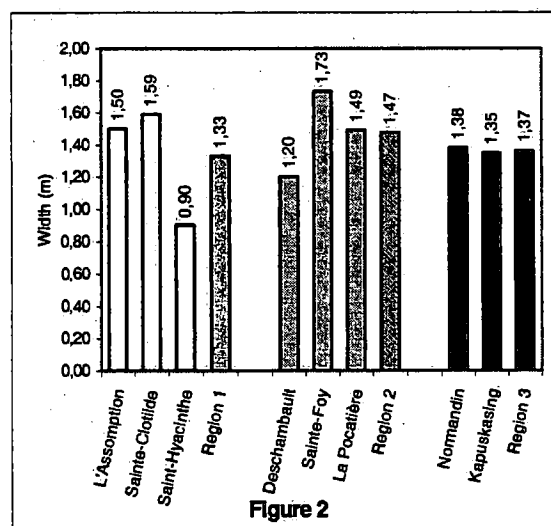


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

The only severe pruning done was at Sainte-Foy, in the last year of the trial. No pruning was done at the other sites.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After two growing seasons, all the shrubs at Saint-Hyacinthe had reached a height of 21-40 cm. At the other sites, it took another year for the shrubs to attain a comparable height. However, the width achieved after two years was greater at Saint-Hyacinthe and Deschambault.

This plant can be produced at all of the trial sites, since its growth is rapid.

HARDINESS EVALUATION

Comparison of the results of this trial with those of previous trials shows that this cultivar can survive beyond zone 2 and can be used as far as zone 2a, with the proviso that growth will be slower there and plants will tend to have a smaller spread.

Full ornamental potential was achieved in zones 4 and 5.

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Juniperus sabina* 'Blue Danube' (Control 1991) from 1992 to 1996

Test site	No damage	Percentage breakdown of damage												Cumulative damage
		WINTER DAMAGE ^a												
	1	2	3	4	5	6	7	8	9	10	11	14		
REGION 1														
L'Assomption	100												0	
Sainte-Clotilde	97							3					3	
Saint-Hyacinthe	94							6					6	
REGION 2														
Deschambault	92							1				7	8	
Sainte-Foy	96											4	4	
La Pocatière	100												0	
REGION 3														
Normandin	95							3		2			5	
Kapuskasing	88	4		3				1		2		2	12	

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Juniperus sabina* 'Blue Danube' (Control 1991) plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	67	100	0	0	0	69	15	0	0	0	-	0	0	0	0
021-040	33	0	83	66	17	31	78	83	9	0	-	100	100	50	0
041-060	0	0	17	34	67	0	7	17	82	82	-	0	0	50	100
061-080	0	0	0	0	16	0	0	0	9	18	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	69	22	17	0	0	100	6	0	0	0	27	18	0	0	0
021-040	31	67	41	0	0	0	94	58	50	0	73	82	100	50	50
041-060	0	11	42	91	9	0	0	42	50	58	0	0	0	50	50
061-080	0	0	0	9	82	0	0	0	0	42	-	-	-	-	-
081-100	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-

REGION 3										
Height (cm)	Normandin					Kapusksing				
	91	92	93	94	95	91	92	93	94	95
001-020	93	38	0	0	0	78	69	10	10	10
021-040	7	62	90	30	20	22	31	90	90	90
041-060	0	0	10	70	80	-	-	-	-	-
061-080	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-

*Dats were collected since 1992.

Table 3. Breakdown of *Juniperus sabina* 'Blue Danube' (Control 1991) plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	83	0	0	0	100	46	0	0	0	-	69	30	0	0
051-100	0	17	100	50	0	0	54	42	18	0	-	31	60	60	0
101-150	0	0	0	50	33	0	0	58	46	27	-	0	10	40	100
151-200	0	0	0	0	67	0	0	0	36	73	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	89	6	0	0	0	100	44	0	0	0	100	27	0	0	0
051-100	11	94	50	64	9	0	56	100	17	0	0	73	38	0	0
101-150	0	0	50	36	91	0	0	0	83	8	0	0	62	87	38
151-200	-	-	-	-	-	0	0	0	0	92	0	0	0	13	62
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	100	85	10	0	0	100	54	30	0	0					
051-100	0	15	90	10	0	0	46	70	40	20					
101-150	0	0	0	80	80	0	0	0	60	30					
151-200	0	0	0	10	20	0	0	0	0	50					

*Data were collected since 1992.

JUNIPERUS SABINA

'BLUE DANUBE' (CONTROL 1992)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Diseases and Insects and Bibliographic References can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume II (VR 221).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: On June 13, 1991, 454 cuttings (15 cm long) were taken from roughly five-year-old parent plants. The cuttings were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed in tap water. After immersion in a fungicide bath (Benomyl-Captan®), they were planted in plug trays filled with peat moss and perlite (1:4; v:v), and placed under a mist unit (Mist-A-Matic®). The rooting rate was 90 % after 80 days. The seedlings were hardened off in late September in the unheated greenhouse, with reduced misting. At this time, they were also treated with a soluble fertilizer (20-20-20, 200 ppm N). In November, they were moved to the cold store, where they were kept at 0 °C in plastic bags perforated with a hatpin. In early May 1992, they were wrapped and returned to the cold store at 4 °C, to await shipping a few days later.

Inclusion in testing network: Seedlings 13 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 17% of the plants suffered mechanical breakage during the last winter.

At Saint-Hyacinthe, one seedling died the first winter. No other damage occurred in this region.

Region 2

No damage occurred at Deschambault and La Pocatière.

At Sainte-Foy, 43 % of seedlings suffered frost damage to the branch tips during the first winter.

Region 3

At Normandin, one plant died the second winter. No other damage occurred.

At Kapuskasing, one shrub died the last winter. During the first winter, frost damage to the branch tips was observed in 15 % of seedlings and foliage browning in 10 % of seedlings. The one-year-old shoots were affected in 8 % of plants during the last two winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the shrubs after five years of testing at each site in the three regions.

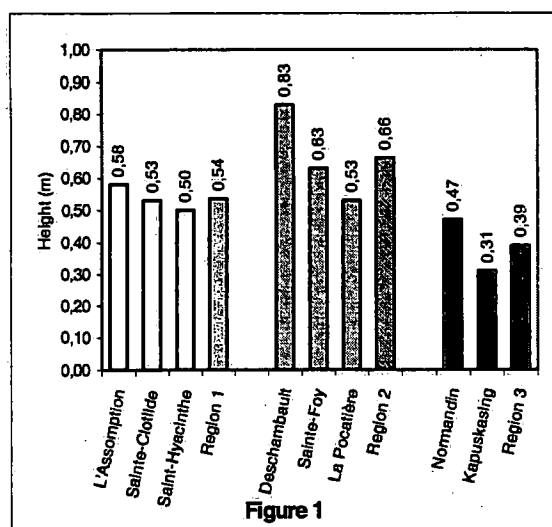


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

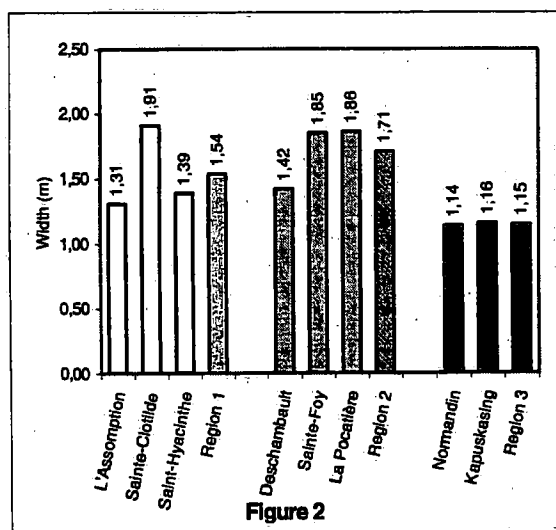


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

The only pruning done was at Normandin, where the shrubs were pruned during the second growing season.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After two growing seasons, over 95 % of shrubs had reached a height of 21-40 cm, except at L'Assomption and Kapuskasing. During the same period, the width achieved was greater at Sainte-Clotilde, Deschambault and La Pocatière, where 80-100 % of shrubs were 51-100 cm wide.

This fast-growing cultivar can be produced at all test sites.

HARDINESS EVALUATION

Comparison of the results of these tests with those of previous trials shows that this cultivar can survive beyond zone 2 and can be used as far as zone 2a, with the proviso that growth will be slower there and plants will tend to have a smaller spread.

Full ornamental potential was achieved in zones 4 and 5.

WRITTEN BY

Claude Richer, Agr.

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Table 1. Frequency of winter damage observed on *Juniperus sabina* 'Blue Danube' (Control 1992) from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ²									
	1	2	3	4	5	6	7	8	10	14	
REGION 1											
L'Assomption	97								3		3
Sainte-Clotilde	100										0
Saint-Hyacinthe	99							1			1
REGION 2											
Deschambault	100										0
Sainte-Foy	92	8									8
La Pocatière	100										0
REGION 3											
Normandin	99							1			1
Kapuskasing	90	3		3				2		2	10

* Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Juniperus sabina* 'Blue Danube' (Control 1992) plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	48	29	0	0	0	43	0	0	0	0	5	5	0	0	0
021-040	52	71	92	50	0	57	95	33	17	0	90	95	100	100	0
041-060	0	0	8	50	75	0	5	67	83	100	0	0	0	0	100
061-080	0	0	0	0	25	-	-	-	-	-	5	0	0	0	0
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	5	0	0	0	0	71	0	0	0	0	19	0	0	0	0
021-040	95	89	8	0	0	29	90	33	0	0	81	100	17	33	0
041-060	0	11	92	33	0	0	10	67	75	34	0	0	83	67	100
061-080	0	0	0	67	50	0	0	0	25	58	-	-	-	-	-
081-100	0	0	0	0	50	0	0	0	0	8	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	85	0	0	0	0	86	33	0	0	0					
021-040	15	100	45	82	9	14	67	100	100	100					
041-060	0	0	55	18	91	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Juniperus sabina* 'Blue Danube' (Control 1992) plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	71	8	0	0	100	19	0	0	0	100	53	17	0	0
051-100	0	29	75	50	0	0	81	25	0	0	0	47	83	92	0
101-150	0	0	17	50	83	0	0	75	42	8	0	0	0	8	92
151-200	0	0	0	0	17	0	0	0	58	67	0	0	0	0	8
211-250	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	0	0	0	0	100	29	0	0	0	100	0	0	0	0
051-100	0	100	92	17	0	0	71	67	0	0	0	100	0	0	0
101-150	0	0	8	83	0	0	0	33	17	0	0	0	100	67	0
151-200	0	0	0	0	75	0	0	0	83	75	0	0	0	33	75
211-250	0	0	0	0	25	0	0	0	0	25	0	0	0	0	25
REGION 3															
Width (cm)	Normandin					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	80	0	0	0	100	95	8	0	0					
051-100	0	20	100	55	9	0	5	92	42	33					
101-150	0	0	0	45	91	0	0	0	58	59					
151-200	-	-	-	-	-	0	0	0	0	8					
211-250	-	-	-	-	-	-	-	-	-	-					

JUNIPERUS SABINA

'BROADMOOR'

Family:	Cupressaceae
English name:	Broadmoor Juniper, Broadmoor Sabin Juniper
French name:	Genévrier 'Broadmoor', sabinier 'Broadmoor'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small shrub grows to about 0.6 m tall and 2.5 m wide. Its dense, compact spreading habit gives it a very regular shape.

The horizontal creeping branches tend to build up in the centre with age, forming a mound. The short twigs, slightly upturned at the tips, resemble those of the cultivar 'Tamariscifolia'. This cultivar is more spreading and vigorous than 'Arcadia'.

The scale-like foliage turns from bluish green in summer to greyish green in winter. The upperside of the needle is resinous and depressed and the underside is whitish with a prominent midvein. The foliage gives off an odour when wet or crushed.

It is a slow-growing cultivar.

ORIGIN AND DISTRIBUTION

Native to southern, western and central Europe, including the Caucasus and Siberia, this cultivar has been grown since 1956 and was introduced in America in 1963 by D. Hill Nurseries.

USE

Ornamental: The shrub is used as a ground cover in rock gardens or in mass plantings. It is very tolerant of road salt.

DISEASES AND INSECTS

This cultivar appears to be little affected by insects. When grown in moist soil, it is susceptible to rusts. It can also succumb to phomopsis blight of juniper (*Phomopsis juniperovora*), which causes dieback. This disease was observed in several plants at Sainte-Foy and Normandin.

REQUIREMENTS

Like *Juniperus sabina* 'Blue Danube', this cultivar prefers dry, chalky soils. It needs full sun and shuns excessive moisture. Pruning is not required. A site sheltered from the wind is preferable.

PROPAGATION

Cuttings: This cultivar can be easily propagated from woody or semi-woody cuttings, taken in fall, winter or from late July to late August. Cuttings should be taken from young plants and include the heel or strip of bark.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (15 cm long) were taken on December 21, 1988, from three-year-old parent plants measuring 10 cm high and 1 m wide. A shallow cut was made at the base of the cuttings and they were dipped for 5 seconds in a 10,000-ppm IBA/50 % ethanol solution. They were then placed in the greenhouse in plug trays filled with Promix® and perlite (1:2; v:v), and misted for 30 seconds every hour. The heating cables were set at 25 °C. The rooting rate was 90 % after nine weeks. The seedlings

were treated with a soluble fertilizer (10-52-10). On May 23, 1989, 360 seedlings were transplanted to the nursery. In fall, they were dug up, puddled and heeled in for the winter. The winter survival rate was 86 %. On May 25, they were transplanted to the nursery, and in fall, the seedlings were dug up, puddled and heeled in until the spring of 1991; the second winter, the survival rate was 100 %. In April, the seedlings were wrapped and placed in the cold room at 5 °C to await shipping in May.

Inclusion in testing network: Seedlings 15 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

One or two seedlings died shortly after transplanting at almost all the sites.

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 38 % and 90 % of plants suffered from foliage browning during the first two winters. No other damage occurred.

Except for a seedling that died the second winter, no damage occurred at Sainte-Clotilde.

At Saint-Hyacinthe, no damage was observed, except for the death of two seedlings the first winter.

Region 2

At Sainte-Foy, the only damage observed was foliage browning, seen every year in 83 %, 34 %, 8 %, 75 % and 33 % of plants respectively.

At Deschambault, 37 % and 8 % of seedlings died the first two winters. Foliage browning was observed in close to half of the shrubs during the first three winters. No other damage occurred subsequently.

No damage occurred at La Pocatière during the tests.

Region 3

At Normandin, one seedling died in each of the first two winters. Foliage browning was observed in 25 % and 33 % of shrubs during the third and fifth winters.

At Kapuskasing, one plant died the second winter. Frost damage to the branch tips occurred in 58 % and 11 % of seedlings during the first two winters. The second winter, 10 % of plants suffered frost damage to the one-year-old shoots and 10 % suffered foliage browning. No damage occurred during the last three winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the shrubs after five years of testing at each site in the three regions.

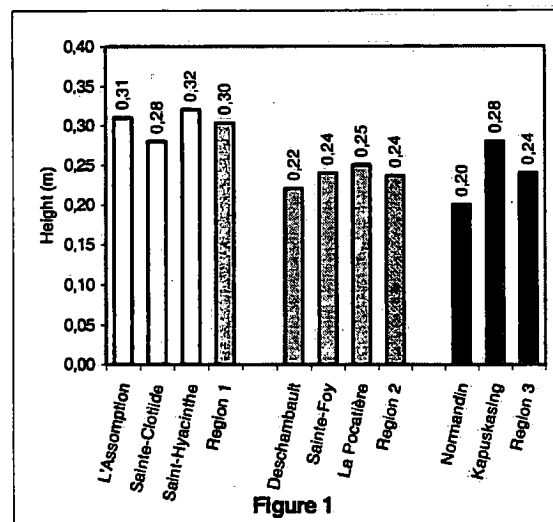


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

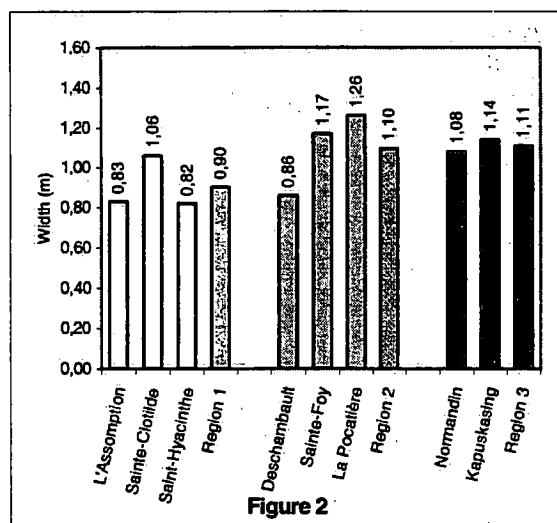


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Height growth did not increase after the third year at Deschambault and the fourth year at Sainte-Foy. All shrubs were twice as wide as they were tall.

Effect of pruning

In general, only training was required for this cultivar. Occasionally, branches with foliage browning had to be removed at Sainte-Foy, Deschambault and Normandin.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After three growing seasons, all shrubs had surpassed 41 cm high at L'Assomption, Sainte-Clotilde, Sainte-Foy, La Pocatière and Kapuskasing. A fourth season was required to obtain shrubs of similar size at the other sites.

Based on the test results, this cultivar can be produced at all sites provided that it is adequately protected by snow cover during the coldest part of the year.

HARDINESS EVALUATION

According to Sherk and Buckley, *Juniperus sabina* and its cultivars are hardy to zone 2. Like the species, this cultivar had no serious damage in zone 2a, which suggests that it would be hardy under slightly more harsh winter conditions.

The cultivar can survive and be used as far as zone 2, while full ornamental potential was achieved at Sainte-Clotilde (zone 5b), Saint-Hyacinthe (zone 5a) and La Pocatière (zone 4a).

This *Juniperus* must be protected by adequate snow cover, since foliage browning, which occurred at a number of sites, diminishes the ornamental appearance of the plant for several weeks in spring.

BIBLIOGRAPHIC REFERENCES

2, 7, 12, 17, 34, 74

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Juniperus sabina* 'Broadmoor' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage												Cumulative damage
		WINTER DAMAGE ^a												
	1	2	3	4	5	6	7	8	9	10	11	14		
REGION 1														
L'Assomption	74											26	26	
Sainte-Clotilde	99							1					1	
Saint-Hyacinthe	98							2					2	
REGION 2														
Deschambault	65							9				26	35	
Sainte-Foy	54											46	46	
La Pocatière	100												0	
REGION 3														
Normandin	86							2				12	14	
Kapuskasing	81	14		2				1				2	19	

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 6, 7, 9, 10 and 11 occurred for this cultivar.

Table 2. Breakdown of *Juniperus sabina* 'Broadmoor' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	24	10	0	0	0	5	37	17	0	0	-	0	0	0	0
011-020	76	90	83	0	0	95	63	58	42	0	-	58	34	17	8
021-030	0	0	17	83	42	0	0	25	50	100	-	42	66	75	34
031-040	0	0	0	17	58	0	0	0	8	0	-	0	0	8	50
041-050	-	-	-	-	-	-	-	-	-	-	-	0	0	0	8
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	34	11	0	0	0	5	0	0	0	0	0	5	0	0	0
011-020	66	78	50	25	8	90	50	57	57	43	90	95	75	66	8
021-030	0	11	50	75	84	5	17	0	43	57	5	0	25	34	92
031-040	0	0	0	0	8	0	33	29	0	0	5	0	0	0	0
041-050	-	-	-	-	-	0	0	14	0	0	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	21	22	0	8	8	0	0	0	0	0					
011-020	79	61	50	50	50	89	84	55	36	0					
021-030	0	11	50	42	42	11	16	45	64	73					
031-040	0	6	0	0	0	0	0	0	0	27					
041-050	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Table 3. Breakdown of *Juniperus sabina* 'Broadmoor' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	80	0	0	0	100	58	0	0	0	-	74	17	0	0
041-080	0	20	100	92	17	0	42	75	17	0	-	26	83	100	50
081-120	0	0	0	8	83	0	0	25	83	92	-	0	0	0	50
121-160	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	74	17	14	0	0	78	28	0	0	0	74	16	0	0	0
041-080	26	83	86	43	57	22	72	83	8	0	26	84	8	0	0
081-120	0	0	0	57	43	0	0	17	92	67	0	0	92	58	33
121-160	0	0	0	0	0	0	0	0	0	33	0	0	0	42	67
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	56	17	0	0	67	42	0	0	0					
041-080	0	44	58	67	8	33	58	73	27	18					
081-120	0	0	25	33	84	0	0	27	73	37					
121-160	0	0	0	0	8	0	0	0	0	45					

*Data were collected since 1992.

JUNIPERUS SCOPULORUM

'BLUE HAVEN'

Family:	Cupressaceae
English name:	Blue Haven Juniper
French name:	Genévrier des Rocheuses 'Blue Haven'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This erect, pyramidal shrub is compact and rather wide, reaching a height of 5 m high and a spread of 1 m.

The branches are vigorous, with erect twigs and young shoots. The scale-like leaves, formed of imbricate scales, are slightly glandular on the underside. Acicular leaves may sometimes be present. The silvery-blue foliage retains its colour throughout the year.

The thin, fibrous, and reddish to reddish-brown bark is divided into thin, interlacing strips.

The many fruits remain on the tree year round. The small round cones, shiny blue-black in colour, take two years to ripen, which means that two generations of seed cones can be found on the same tree.

The shrub is shallow rooted.

ORIGIN AND DISTRIBUTION

Native to the mountainous regions of western North America, the species is found in the foothills of the Rockies in southern Alberta west to southern British Columbia, where it occurs in montane forests and the drier parts of the coastal forest region. The cultivar 'Blue Heaven' is a natural cultivar and has been propagated by grafting since its discovery.

USE

Ornamental: This cultivar is frequently used in landscaping. It can be used as a specimen plant or in mass plantings, contrasted with other conifers or shrubs.

REQUIREMENTS

A sunny location is indispensable. This cultivar is adapted to rocky, calcareous soils and dislikes excessive moisture. It is very hardy but protection against the winter wind is beneficial during the first few years after planting. Training is used to increase foliage density. Due to the shallow root system, mounding the dirt around the roots when planting is advised.

DISEASES AND INSECTS

Phomopsis blight (*Phomopsis juniperovora*) attacks most junipers. Cedar rusts (*Gymnosporangium clavipes*, *Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*) are fungal diseases requiring a primary host to begin their life cycle. All junipers may act as primary hosts, with *Juniperus scopulorum* and its cultivars and varieties being among the most susceptible. *Alternaria* and *Epicoccum* are other fungal diseases that may also cause serious damage.

The main insect pests attacking junipers include scale insects (Fletcher scale), mites and spittlebugs.

PROPAGATION

Cuttings: Cuttings with heels, preferably from young plants, are taken from late July to late August before the twigs turn brown. Hormone treatments improve results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings were taken on January 14, 1991, from 15-year-old parent plants measuring roughly 5.0 m high and 1.3 m wide. A shallow cut was made at the base of the cuttings and they were dipped for 5 seconds in a 20,000-ppm IBA/50 % ethanol solution. They were then placed in plug trays (45 plugs) filled with perlite and Promix® (2:2; v:v), and put in the greenhouse under a mist unit operating 6 seconds every hour. The heating cables were set at 22 °C. Weekly treatments with a Benomyl®-based fungicide were provided throughout the propagation period. The rooting rate was 50 % after eight weeks. In mid-April, misting was discontinued and the seedlings were kept in the plug trays, and treated with a 10-52-10 fertilizer at the recommended rate. On June 14, 1991, they were repotted in 10-cm pots in a mixture of Promix®, Turface® and compost (Fafard et Frères Ltée) (1:1:1; v:v:v), and treated again with 10-52-10 fertilizer. The seedlings were put in cold frames to overwinter without any other protection. On April 26, 1992, they were wrapped and put in a cellar to await shipping.

Inclusion in testing network: Seedlings 15 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage occurred at L'Assomption or Sainte-Clotilde. One shrub died at Saint-Hyacinthe during the last winter.

Region 2

At Sainte-Foy, frost damage to the branch tips occurred in 95 %, 10 %, 16 % and 17 % of shrubs during the first four winters. No other damage occurred.

At Deschambault, foliage browning was observed in 80 % of plants during the second winter. In addition, frost damage to the branch tips occurred in one shrub the first winter and damage from the weight of the snow was observed in one shrub during the third and fifth winters.

At La Pocatière, one seedling died the first winter. The following winter, frost damage to the branch tips affected 95 % of the plants.

Region 3

At Normandin, 10 % and 5 % of seedlings died the first two winters. The last winter, 90 % of shrubs were damaged by the weight of the snow.

At Kapuskasing, 15 %, 11 % and 18 % of plants died during the first three winters. Frost damage to the previous year's shoots occurred in 33 %, 18 % and 9 % of shrubs the first, third and fourth winters. In addition, 15 %, 5 %, 19 % and 5 % of shrubs suffered frost damage to the branch tips, damage to the entire aerial portion of the plant, foliage browning and mechanical breakage respectively during the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

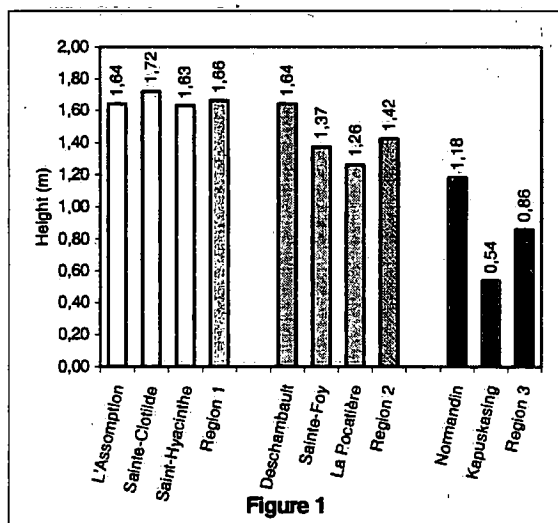


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

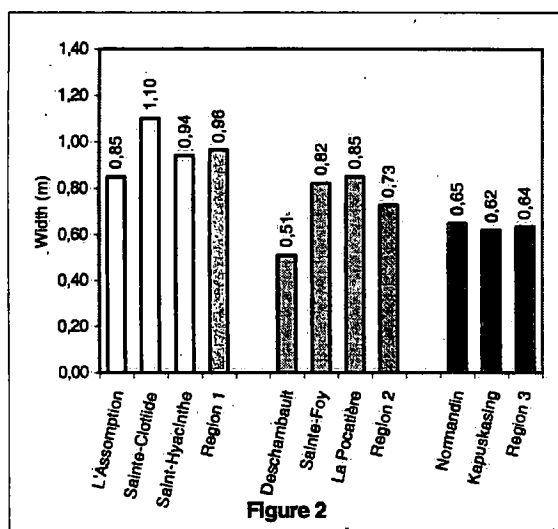


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth was particularly slow at Kapuskasing. At the other sites, however, height increased every year.

Effect of pruning

The plants at Sainte-Clotilde and Kapuskasing were pruned. The second year, over a third of their annual growth was pruned back.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After two growing seasons, close to 90 % of shrubs were over 51 cm tall at all sites except La Pocatière and Kapuskasing. A third season was required at La Pocatière, whereas at Kapuskasing the shrubs did not even reach this height after five years.

Width growth was variable from site to site. After three growing seasons, 60-80 % of plants at Sainte-Clotilde, Normandin, Sainte-Foy and Saint-Hyacinthe had reached a width of 41-80 cm.

This cultivar can be produced at all the test sites except those in zone 2a. Growth is comparable in the various regions.

HARDINESS EVALUATION

According to the literature, this cultivar's hardiness is highly variable, with some authors placing it in zone 2, and others in zone 3 or zone 4a. The test results show that the cultivar can survive as far as zone 2b and even zone 2a, with the proviso that the plants may die at a young age.

The cultivar can be used as far as zone 2, although growth in zone 2a will be slower. It must be protected from mechanical breakage caused by the weight of the snow. Full ornamental potential was achieved in zones 5a and 5b.

BIBLIOGRAPHIC REFERENCES

3, 7, 9, 27, 32, 33, 39

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Juniperus scopulorum* 'Blue Haven' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	10	11	14	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	100										0
Saint-Hyacinthe	98							2			2
REGION 2											
Deschambault	79	2							3	16	21
Sainte-Foy	72	28									28
La Pocatière	80	19						1			20
REGION 3											
Normandin	64							3	18	15	36
Kapuskasing	71	3	12				1	8	1	4	29

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 6, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Juniperus scopulorum* 'Blue Haven' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	5	0	0	0	100	11	0	0	0	76	14	5	8	0
051-100	0	95	75	0	0	0	89	68	0	0	24	86	85	17	9
101-150	0	0	25	100	8	0	0	32	100	8	0	0	10	75	9
151-200	0	0	0	0	92	0	0	0	0	92	0	0	0	0	82
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	90	10	0	0	0	100	19	0	0	0	90	25	0	0	0
051-100	10	90	83	0	0	0	81	100	8	0	10	75	100	50	0
101-150	0	0	17	100	8	0	0	0	92	92	0	0	0	50	73
151-200	0	0	0	0	92	0	0	0	0	8	0	0	0	0	27
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	11	0	0	0	100	100	100	73	67					
051-100	0	89	100	64	9	0	0	0	27	33					
101-150	0	0	0	36	91	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Juniperus scopulorum* 'Blue Haven' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	83	8	0	100	47	21	0	0	100	100	34	17	0
041-080	0	0	17	92	25	0	53	79	75	0	0	0	66	67	9
081-120	0	0	0	0	75	0	0	0	25	92	0	0	0	8	91
121-160	-	-	-	-	-	0	0	0	0	8	0	0	0	8	0
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	100	25	0	100	100	33	0	0	100	95	42	0	0
041-080	0	0	0	75	100	0	0	67	100	58	0	5	58	100	18
081-120	-	-	-	-	-	0	0	0	0	42	0	0	0	0	82
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	100	27	0	0	100	100	82	27	11					
041-080	0	0	73	100	100	0	0	18	73	89					
081-120	-	-	-	-	-	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

LARIX KAEMPFERI (LAMB.) CARR.

Family:	Pinaceae
English name:	Japanese Larch
French name:	Mélèze du Japon
Synonym:	<i>Larix leptolepis</i>
Category:	Narrow-leaved deciduous tree
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This broad, pyramidal tree, with a regular, rigid growth habit, can grow 40 m high in its home country, and 15 m high and 6 m wide in Canadian conditions.

The trunk has reddish brown, slightly fissured bark.

The irregularly spreading horizontal branches have drooping ends. The thin branches are reddish and bloom-covered and, for the most part, brittle and non-resinous.

Under the magnifying glass the tiny leaf scars show only one vein scar.

The buds are prominent and rounded. The soft, deciduous needles are in whorls of more than 40 on the short branches and measure from 1.5 to 3.5 cm in length. The broad needles have two white stripes on the back. The young spring leaves are pale green in colour, contrasting with the clear pink of the young cones. They later turn bluish green on top and greyish underneath, then, in the fall, yellow shading into orange.

The seedlings form yellow male catkins and green and pink female cones. The erect, pedunculated cones are brown, globular, wider than they are high, and measure 2 to 3 cm in diameter. They have thirty scales; the short wing of the seed does not extend to the edge of the scale, which bends outward.

The roots lie close to the surface.

ORIGIN AND DISTRIBUTION

This species, native to Japan, is also found in of forests of Western Europe. Its life expectancy is from 50 to 100 years.

USE

Ornamental: In large spaces, this species is used by itself or as part of a grouping, combined with other conifers for its graceful habit and its foliage, which turns ochre yellow in the fall. It is attractive when used to form screens or windbreaks.

Naturalization: This larch is used for reforestation; it grows quickly in the open.

Cabinetmaking: The wood of this species is used as timber.

REQUIREMENTS

As with all other larches, the *kaempferi* species requires a sunny location. It prefers light, acid, cool soils and is averse to excessive dampness and drought alike. High atmospheric humidity is essential to it, however. The species tolerates urban conditions well. Its growth is rapid in the juvenile phase.

DISEASES AND INSECTS

Spruce canker (*Cytospora kunzei*) and rust (*Melampsora* sp.) are fungal diseases that may develop on larches opportunistically or because of breakage or injury. The Japanese larch is less susceptible to canker than other larches.

PROPAGATION

Seeds: The seeds ripen in late fall. The cones are harvested and exposed to heat to force them open. Then, the seeds are stratified and sown in the spring. As with most conifers, it is helpful to cover the seedlings with conifer branches to provide shade and moisture.

Grafting: This species is grafted onto root sections in half-clefts.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: The cones were harvested on October 20, 1988 and the seeds extracted manually, then stored. They were sown on November 16, 1989 to a depth of 10 mm in a medium of Promix® and sand (1:2; v:v) and shaded with a cloth (63 %). Seedlings were observed to sprout on May 24, 1991; they were transplanted to the nursery and cultivated until the fall. They were then pulled up, puddled and heeled in. The 22 April 1992, they were wrapped, puddled and stored in a cellar until their shipment.

Inclusion in testing network: Young seedlings 17 cm tall were planted at eight trial sites throughout Quebec and northeastern Ontario. Their over-winter survival and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

The frequency of winter damage to this species observed over 5 years is presented in Table 1. The details of the main damage that occurred each winter at each of the sites are given below.

Region 1

In L'Assomption, one seedling died the third winter. Frost damage to stem tips was observed on one seedling the first winter.

In Sainte-Clotilde, 15 %, 65 % and 17 % of the seedlings died over the first three winters. In addition, frost damage

to stem tips occurred on 11 % of the seedlings the second winter.

In Saint-Hyacinthe, 6 %, 8 %, 37 % and 48 % of the seedlings died during the first four winters, leaving only three seedlings for evaluation. The surviving seedlings suffered no damage.

Region 2

In Sainte-Foy, one seedling died the first winter and damage to stem tips occurred on one seedling.

In Deschambault, frost damage to stem tips was observed on 35 % and 16 % of the seedlings the second and third winters. One seedling suffered damage from mechanical breakage the second winter.

In La Pocatière, frost damage to stem tips occurred on 74 % of the seedlings the second winter.

Region 3

In Normandin, 11 % of the seedlings died and another 11 % suffered frost damage to stem tips the first winter. Also, mechanical breakage occurred on 10 % and 80 % of the seedlings the third and fifth winters.

In Kapuskasing, 5 %, 17 % and 20 % of the seedlings died during the first, third and fourth winters. Frost damage occurred on stem tips the first three winters on 62 %, 55 % and 58 % of the seedlings. Frost damage to the one-year shoot occurred on 14 %, 25 %, 8 % and 20 % of the seedlings the first four winters.

Height and width growth

Figures 1 and 2 show the average height and width of seedlings after five years of trials at each site and region.

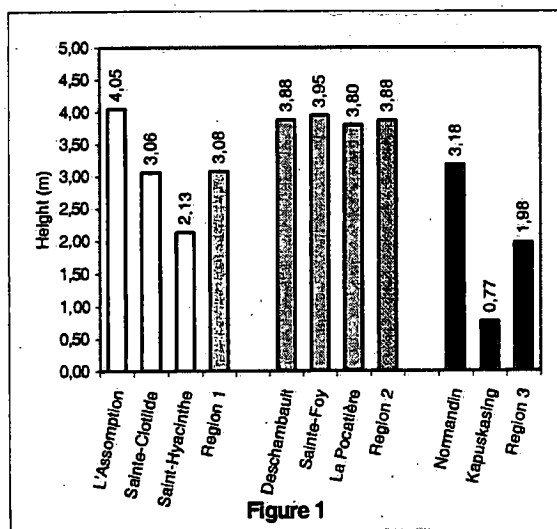


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

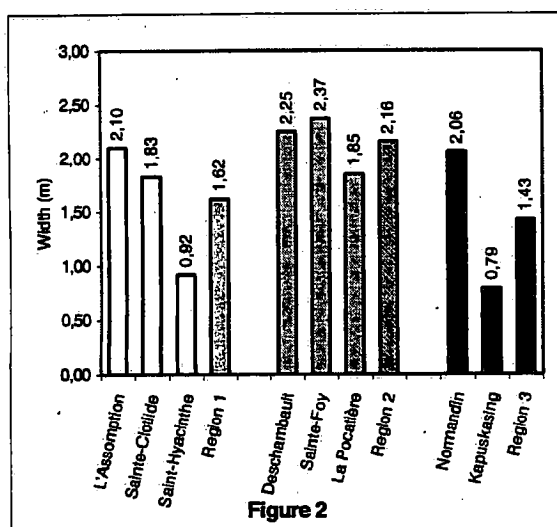


Figure 2. Mean width of trees at trial's end at eight sites and three regions

There are large differences in seedling height between sites of a given region. The trees of Kapuskasing showed very slow annual growth.

Effect of pruning

At the La Pocatière and Normandin sites, the seedlings were cut back by a third of their height the second year. No other pruning was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and width obtained after each year. Nursery growers will find these tables useful for estimating annual production as well as the number of years needed to obtain a predetermined height and width.

After two years of cultivation, all the surviving seedlings had reached more than 1.01 m in height at all sites except Kapuskasing. However, the seedlings in Saint-Hyacinthe ceased to grow as of the third year and only three seedlings survived for testing, and these were small and stunted.

During the first few years, the seedlings at sites in region 2 and in Normandin were larger than those in other regions, but the difference disappeared as time went on, except in Kapuskasing.

This plant has been difficult to produce at sites in the Montreal region because of the high mortality that occurred as time went on. The lack of snow in early fall or the prolonged lack of snow during the coldest periods of the winter limit production of young specimens of this species in unsheltered areas.

HARDINESS EVALUATION

A comparison of results for this species with those for Tamarack shows that the Japanese Larch is less hardy and less suited to our conditions.

The survival potential of this species extends to zone 2b: the Normandin seedlings showed little mortality, and during the first winter only. However, in sites of zone 5, few young seedlings survived on the South Shore, as snowfall was insufficient during the fall or too spotty during the winter to suitably protect the root system.

Its potential for use may extend also to zone 2b, as it grew well at the Normandin site.

The plant's full potential for ornamental character was not expressed in this trial.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 17, 28, 33, 39, 73, 77

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Larix kaempferi* (Lamb.) Carr. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	97	1						2			3
Sainte-Clotilde	78	2						20			22
Saint-Hyacinthe	70							30			30
REGION 2											
Deschambault	89	10							1		11
Sainte-Foy	98	1						1			2
La Pocatière	85	15									15
REGION 3											
Normandin	78	2						2	18		22
Kapuskasing	43	35		13				9			57

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Larix kaempferi* (Lamb.) Carr. plants by marketable height category from 1992 to 1996

REGION 1															
Height	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
(cm)	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	52	0	0	0	100	24	0	0	0	100	82	55	43	-
101-200	0	48	67	0	0	0	76	80	60	0	0	18	36	43	-
201-300	0	0	33	55	9	0	0	20	40	80	0	0	9	14	-
301-400	0	0	0	45	27	-	-	-	-	-	-	-	-	-	-
401-500	0	0	0	0	55	0	0	0	0	20	-	-	-	-	-
501-600	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-

REGION 2															
Height	Deschambault					Sainte-Foy					La Pocatière				
(cm)	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	20	0	0	0	100	11	0	0	0	100	37	0	0	0
101-200	0	80	67	0	0	0	89	73	0	0	0	63	42	8	0
201-300	0	0	33	75	0	0	0	27	55	0	0	0	58	67	0
301-400	0	0	0	25	58	0	0	0	45	55	0	0	0	25	58
401-500	0	0	0	0	42	0	0	0	0	45	0	0	0	0	42
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

REGION 3															
Height	Normandin					Kapuskasing									
(cm)	92	93	94	95	96	92	93	94	95	96					
001-100	100	12	10	10	10	100	100	92	90	62					
101-200	0	88	80	20	0	0	0	8	10	38					
201-300	0	0	10	40	30	-	-	-	-	-					
301-400	0	0	0	30	40	-	-	-	-	-					
401-500	0	0	0	0	20	-	-	-	-	-					
501-600	-	-	-	-	-	-	-	-	-	-					

*Datan were collected until 1995.

Table 3. Breakdown of *Larix kaempferi* (Lamb.) Carr. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	95	38	0	0	0	100	0	0	0	0	89	41	0	0	-
051-100	5	62	42	0	0	0	88	40	0	0	11	59	82	71	-
101-150	0	0	50	45	0	0	12	60	80	20	0	0	18	29	-
151-200	0	0	8	55	45	0	0	0	20	40	-	-	-	-	-
201-250	0	0	0	0	46	0	0	0	0	40	-	-	-	-	-
251-300	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	70	0	0	0	0	53	0	0	0	0	100	0	0	0	0
051-100	30	55	0	0	0	47	72	0	0	0	0	100	8	0	0
101-150	0	45	83	17	0	0	28	36	0	0	0	0	67	42	0
151-200	0	0	17	83	0	0	0	64	91	9	0	0	25	58	67
201-250	0	0	0	0	100	0	0	0	9	73	0	0	0	0	33
251-300	-	-	-	-	-	0	0	0	0	18	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	17	0	0	0	95	60	50	40	12					
051-100	0	53	10	0	0	5	40	50	50	63					
101-150	0	30	80	10	10	0	0	0	10	25					
151-200	0	0	10	60	30	-	-	-	-	-					
201-250	0	0	0	30	60	-	-	-	-	-					
251-300	-	-	-	-	-	-	-	-	-	-					

*Dats were collected until 1995.

LARIX LARICINA

(DU ROI) K. KOCH. (CONTROL 1992)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology and Insects, Propagation and Bibliographical References were previously published in the volume *Hardiness and Growth of Woody Ornamental Plants in Quebec* (95-0070).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Berthierville forest tree nursery, Berthier (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds were received on November 18, 1988 and sown on November 25 at a depth of 10 mm in a medium of Promix® and sand (1:3; v:v) and shaded with a cloth (63 %). The seedling sprouted in June 1989. They were cultivated and fertilized in beds until October 1990, at which time they were pulled up and heeled in. On May 23, 1991, they were transplanted to the nursery and cultivated until the fall. They were pulled up, puddled and heeled in once again. The 22 April 1992, they were wrapped, puddled and placed in cold storage until their shipment.

Inclusion in testing network: Young seedlings 32 cm tall were planted in eight trial sites throughout Quebec and northeastern Ontario. Their over-winter survival and their growth potential was evaluated of 1992 to 1997.

RESULTS (1992-97)

Winter damage

The frequency of winter damage to this species observed over 5 years is shown in Table 1. The details of the main

damage that occurred each winter at each of the sites are given below.

Region 1

No damage occurred in the sites of L'Assomption and of Sainte-Clotilde.

In Saint-Hyacinthe, three seedlings in replication 2 died during the third winter. This localized die-off probably resulted from a progressive weakening of the seedlings caused by a leaf chlorosis.

Region 2

In Sainte-Foy and La Pocatière, no damage occurred.

In Deschambault, frost damage to stem tips was observed following the second and fourth winters on 5 % and 15 % of the seedlings. Mechanical breakage of stems occurred the first two winters and the last, to 5 %, 15 % and 8 % of the seedlings.

Region 3

No damage occurred at the Normandin and Kapuskasing sites.

Height and width growth

Figures 1 and 2 show the average height and width of seedlings after five years of trials at each site and region.

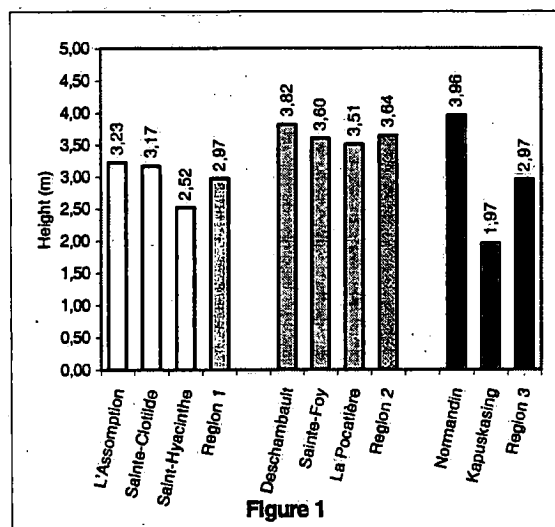


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

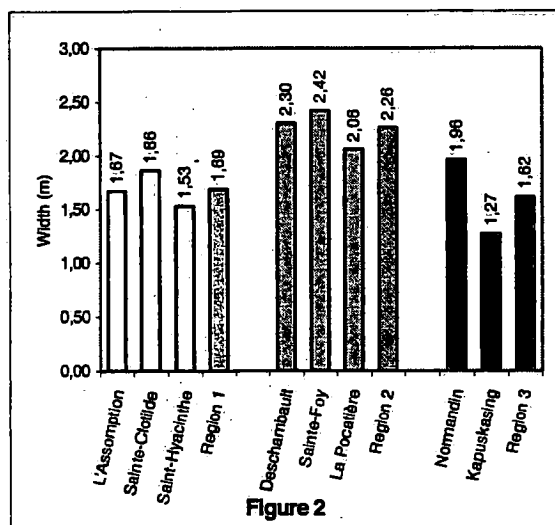


Figure 2. Mean width of trees at trial's end at each of the eight sites and three regions

The annual growth of seedlings was very rapid at the Normandin site and slower in Kapuskasing. It was constant each year at all sites and the seedling height doubled the second year.

Effect of pruning

No serious pruning was done except in the third year in Sainte-Clotilde, where the seedlings were cut back by half.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and width obtained after each year. Nursery growers will find these tables useful for estimating annual production as well as the number of years needed to obtain a predetermined height and width.

After two years of cultivation, more than 90 % of the seedlings being evaluated had reached a height of more than 1.01 m at the Saint-Hyacinthe, Deschambault, Sainte-Foy and Normandin sites. An additional year was required at the La Pocatière, L'Assomption and Sainte-Clotilde sites to obtain seedlings of comparable height, while a fourth year was required in Kapuskasing.

In Quebec City area sites (Sainte-Foy, Deschambault and La Pocatière), the growth in width was faster than at Montreal area sites (L'Assomption, Saint-Hyacinthe and Sainte-Clotilde) or those of the coldest area (Normandin and Kapuskasing).

This plant may be produced at all trial sites, but in Kapuskasing its growth is slower.

HARDINESS EVALUATION

A comparison of results of this trial with those of previous ones confirms that this species can survive, be used and express its full potential for ornamental character in zone 2.

The causes of failure to thrive in woody plants are very varied and often hard to know. The mortality observed in Saint-Hyacinthe, in one of the replications, cannot be ascribed to a lack of hardiness. However, a number of factors may work together to bring about the death of a tree. The analysis of the various possible explanations is not easy and, very often, it is not possible to determine the first cause of a plant's decline. In general, it is detected

late, when a number of parasitic factors have been added. In this specific case, the mortality cannot be ascribed to local soil conditions either, as this species can adapt to poorly drained locations, marshes or bogs.

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Table 1. Frequency of winter damage observed on *Larix laricina* (Du Roi) K. Koch (Control 1992) from 1993 to 1997

Test sites	No damage	Distribution of percentage damage									Cumulative damage
		WINTER DAMAGE									
	1	2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	100										0
Saint-Hyacinthe	80							20			20
REGION 2											
Deschambault	87	8							5		13
Sainte-Foy	100										0
La Pocatière	100										0
REGION 3											
Normandin	100										0
Kapuskasing	100										0

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of types 3, 4, 5, 6, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Larix laricina* (Du Roi) K. Koch (Control 1992) plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	24	0	0	0	100	29	0	0	0	100	10	0	0	0
101-200	0	76	75	25	0	0	71	75	8	0	0	90	67	25	0
201-300	0	0	25	75	33	0	0	25	84	25	0	0	33	75	89
301-400	0	0	0	0	59	0	0	0	8	75	0	0	0	0	11
401-500	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	95	5	0	0	0	100	5	0	0	0	100	15	0	0	0
101-200	5	95	17	0	0	0	95	25	8	0	0	85	18	0	0
201-300	0	0	83	25	0	0	0	75	42	8	0	0	82	82	0
301-400	0	0	0	75	58	0	0	0	50	75	0	0	0	18	82
401-500	0	0	0	0	42	0	0	0	0	17	0	0	0	0	18
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-100	52	10	0	0	0	100	90	17	8	0					
101-200	48	71	25	0	0	0	10	83	92	50					
201-300	0	19	75	25	0	0	0	0	0	50					
301-400	0	0	0	75	50	-	-	-	-	-					
401-500	0	0	0	0	50	-	-	-	-	-					

Table 3. Breakdown of *Larix laricina* (Du Roi) K. Koch (Control 1992) plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	100	83	17	0	100	90	42	8	0	100	100	67	33	11
101-200	0	0	17	83	83	0	10	58	92	75	0	0	33	67	89
201-300	0	0	0	0	17	0	0	0	0	25	-	-	-	-	-
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	100	67	8	0	0	100	89	0	0	0	100	85	0	0	0
101-200	0	33	92	92	8	0	11	100	67	17	0	15	100	91	45
201-300	0	0	0	8	92	0	0	0	33	75	0	0	0	9	55
301-400	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-100	100	100	83	17	0	100	90	42	8	0					
101-200	0	0	17	83	83	0	10	58	92	75					
201-300	0	0	0	0	17	0	0	0	0	25					
301-400	-	-	-	-	-	-	-	-	-	-					

LIGUSTRUM X VICARYI REHD.

Family:	Oleaceae
English name:	Vicary Golden Privet
French name:	Troène doré
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This bush, with a spreading growth habit, measures barely 0.5 m in height and width.

The lanceolate, oval leaves are opposite, with short leaf stalks. Bright yellow at the time of budbreak, they then take on a greenish-yellow tinge.

The white flowers, which form clusters at the stem ends, appear in July. The bell-shaped calyx contains rather indistinct sepals. The two stamens end in four spreading lobes.

The fruits appear toward the end of the summer in the form of small dark red berries.

The many fine roots lie close to the surface.

ORIGIN AND DISTRIBUTION

This hybrid is the result of a cross between *L. ovalifolium* 'Aureum' and *L. vulgare* that was carried out in England around 1920.

USE

Ornamental: This plant, valued for the colour of its foliage, is integrated into gardens by itself or in association with other bushes. It tolerates city conditions well.

REQUIREMENTS

This species needs full sun to retain its colour. It is not demanding as to soil type, and seems insensitive to drought or excessive moisture.

DISEASES AND INSECTS

The Black Vine Weevil (*Otiorhynchus sulcatus*) and the Strawberry Root Weevil (*Otiorhynchus ovatus*) are the main insects that may damage privet species.

PROPAGATION

Cuttings: Semi-hardwood cuttings soaked in a solution of IBA and placed in a medium of sand and peat will root easily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Kentville Research Station, Agriculture and Agri-Food Canada, Kentville (Nova Scotia)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: Four hundred 6 cm cuttings were taken on July 12, 1990 from 8-year-old parent plants about 50 cm tall and 40 cm wide. They were soaked in a solution of 5,000 ppm IBA and 50 % ethanol. They were placed in multipots filled with a medium of Promix® and sand (1:2; v:v), then set out for misting (Mist-A-Matic®). The temperature of heating cables was set at 25 °C. A weekly fungicidal treatment using Benomyl® was applied throughout the propagation period. The rooting rate was 99 % after 3 weeks. Misting was stopped and the seedlings fertilized with a solution of 10-52-10 at the recommended dose. On August 6, the seedlings were potted, fertilized once again with a solution of 10-52-10 and placed in a bed until the spring of 1992. The winter survival rate was 95 %. On April 26, they were packaged and stored in cold storage until their shipment in May.

Inclusion in testing network: Young seedlings 10 cm tall were planted at eight trial sites all across Quebec and northwestern Ontario. Their winter survival and their growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Recovery after transplantation was poor at some sites, eliminating 2, 7, 1, 10, 8 and 4 seedlings at the Sainte-Clotilde, Saint-Hyacinthe, Sainte-Foy, Deschambault, La Pocatière and Kapuskasing sites.

Winter damage

The frequency of winter damage observed over 5 years on this cultivar is given in Table 1. The details of the chief damage sustained each winter at each of the sites is given below.

Seedling mortality especially occurred during the first winter.

Region 1

Six seedlings died during the first winter in L'Assomption. Frost damage to stem ends was observed each winter with the exception of the last, when 64 % of the bushes suffered damage to the above-ground portion (above the snow cover).

In Sainte-Clotilde, three seedlings died during the trial. Stem end damage was recorded during the first four winters on 8 %, 33 %, 67 % and 25 % of the seedlings. The fourth winter, damage to the one-year shoot was observed on 33 % of the seedlings.

In Saint-Hyacinthe, seven seedlings died the first winter. Stem end damage occurred the second and third winters on half of the seedlings.

Region 2

In Sainte-Foy, eight seedlings died the first winter. Stem end damage was observed on 37 %, 100 %, 22 %, 11 % and 44 % of the seedlings. In addition, 16 % of the seedlings showed damage to the previous year's shoot the first winter.

In Deschambault, seven seedlings died the first winter. Stem end damage was observed on 100 %, 25 % and 75 % of the seedlings the second, fourth and fifth winters.

In La Pocatière, seven seedlings died the first winter. Also, 15 %, 16 % and 8 % of the surviving seedlings had stem end damage to the one-year shoot and on all above-ground portions. The second winter, two other seedlings died, two seedlings had stem end damage, and the remaining two showed damage to the above-ground portion above the snow cover.

Region 3

In Normandin, 17 seedlings died the first winter and two more the following winter, leaving two seedlings to be evaluated. The latter suffered stem end damage the third and fourth winters and damage to the one-year shoot the last winter.

In Kapuskasing, 14 of 17 seedlings died during the first two winters and another one the fourth winter. Then, stem end damage and damage to the previous year's shoot was observed on the two seedlings being evaluated.

Height and width growth

Figures 1 and 2 show the average height and width of seedlings after five years of trials at each site and region.

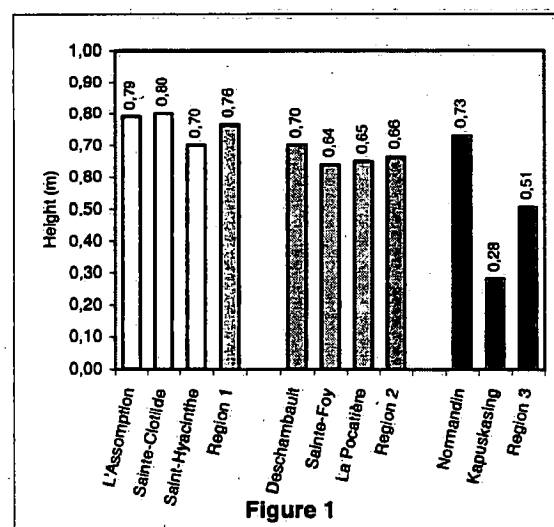


Figure 1. Mean height of shrubs at end of trial at each of the eight sites and three regions

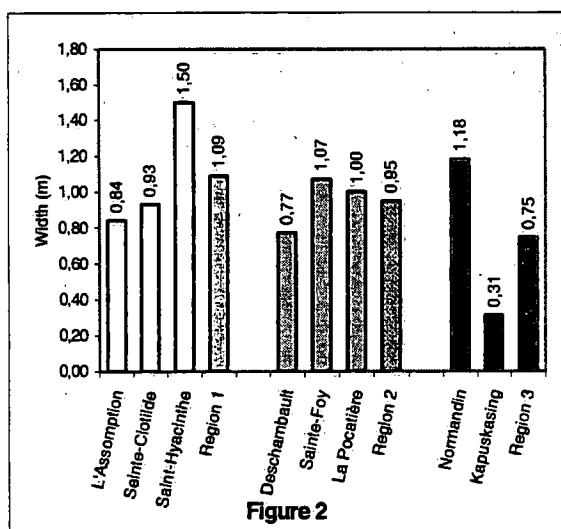


Figure 2. Mean width of shrubs at end of trial at each of the eight sites and three regions

The heights were relatively homogeneous within regions 1 and 2. Kapuskasing brought down its regional average.

Width exceeded height at all sites with the exception of L'Assomption and Sainte-Clotilde.

The seedlings were all wider than they are high right from the third year at all sites.

Effect of pruning

Some light pruning was done in regions 1 and 2 to alleviate frost damage. Pruning was relatively heavier in region 3, especially in Kapuskasing, where the frost damage was more serious.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and width obtained after each year. Nursery growers will find these tables useful for estimating annual production as well as the number of years needed to obtain a predetermined height and width.

Even though this species is recognized for easy recovery on transplantation, a number of trial seedlings died shortly after planting or during the first winter.

More than 75 % of the bushes at the Sainte-Clotilde and Saint-Hyacinthe sites reached a height of more than 40 cm during the third year. A fourth year was needed at all other sites (except Kapuskasing) to obtain seedlings of comparable height.

HARDINESS EVALUATION

The hardiness rating of this species varies from zone 4b to zone 6 according to the references consulted. Trial results show that the seedlings that survive the first winter may survive and develop their potential for use as far as zone 2b. The full ornamental potential of this species is expressed only beyond the trial zones.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 9, 18, 21, 28, 33

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Ligustrum x vicaryi* Rehd. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	6	7	8	9	10	11	
REGION 1											
L'Assomption	0	82			13		5				100
Sainte-Clotilde	62	27		6			5				38
Saint-Hyacinthe	70	20					10				30
REGION 2											
Deschambault	44	44					12				56
Sainte-Foy	45	43		3			9				55
La Pocatière	61	10		3	7	2	17				39
REGION 3											
Normandin	30	38		10			22				70
Kapuskasing	7	46		8		9	30				93

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 9, 10 and 11 occurred for this species.

Table 2. Breakdown of *Ligustrum x vicaryi* Rehd. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	90	60	0	0	0	95	17	8	0	0	86	14	0	0	0
021-040	10	40	67	8	0	5	61	17	16	0	14	29	0	0	0
041-060	0	0	33	75	8	0	22	42	0	0	0	57	67	67	0
061-080	0	0	0	17	58	0	0	25	25	20	0	0	33	33	100
081-100	0	0	0	0	25	0	0	8	59	80	-	-	-	-	-
101-120	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	75	50	25	0	95	55	0	0	0	92	67	0	0	0
021-040	0	25	25	25	25	5	36	33	0	0	8	0	75	25	0
041-060	0	0	25	25	25	0	9	67	33	33	0	33	25	75	25
061-080	0	0	0	25	25	0	0	0	45	56	0	0	0	0	75
081-100	0	0	0	0	25	0	0	0	22	11	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-020	90	25	0	0	0	100	100	100	100	0					
021-040	10	75	100	0	0	0	0	0	0	100					
041-060	0	0	0	50	0	-	-	-	-	-					
061-080	0	0	0	50	100	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Ligustrum x vicaryi* Rehd. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	67	0	0	100	72	17	17	0	100	14	0	0	0
041-080	0	0	33	92	50	0	28	75	0	0	0	86	34	0	0
081-120	0	0	0	8	50	0	0	8	83	100	0	0	66	84	0
121-160	-	-	-	-	-	-	-	-	-	-	0	0	0	16	50
161-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	50
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	75	50	25	100	81	0	0	0	100	66	50	0	0
041-080	0	0	25	25	50	0	19	89	0	0	0	34	50	75	25
081-120	0	0	0	25	0	0	0	11	89	78	0	0	0	25	50
121-160	0	0	0	0	25	0	0	0	11	22	0	0	0	0	25
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	100	100	0	0	100	100	100	100	0					
041-080	0	0	0	0	0	0	0	0	0	100					
081-120	0	0	0	100	50	-	-	-	-	-					
121-160	0	0	0	0	50	-	-	-	-	-					
161-200	-	-	-	-	-	-	-	-	-	-					

LONICERA WEBBIANA WALL.

Family:	Caprifoliaceae
English name:	Honeysuckle
French name:	Chèvrefeuille d'Asie
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This bush may reach 3.0 m high and 0.7 m wide.

A light down may cover the numerous and vigorous young shoots.

The dark green and very dense foliage is made up of elliptical to ovoid leaves, acuminate at the apex, from 6 to 12 cm long. Carried on downy leafstalks from 5 to 10 mm long, they have generally downy faces, though the upper face is sometimes glabrous.

The flowers, yellow with red stripes, come out in late spring. The downy peduncle is from 2 to 3 cm long.

The fruits, small ellipsoidal berries, appear in mid-summer and become purple when ripe.

The roots lie near the surface and are very fine. Growth is average.

ORIGIN AND DISTRIBUTION

This species, which has been grown since 1885, comes from southeastern Europe and its area of distribution extends as far as Afghanistan and the Himalayas.

USE

Ornamental: This plant is attractive because of its flowers and fruits, which are attractive to birds. Used by itself or in groupings, it adapts easily to a variety of conditions.

REQUIREMENTS

This species gives better results when planted in full sun, but can tolerate light shade. It is indifferent to soil texture but needs a well drained soil. It may be pruned after flowering, as the flowers appear on the two-year-old wood.

DISEASES AND INSECTS

No specific reference is on file for this species in the recommendations of Quebec's Réseau d'avertissements phytosanitaires [plant health warning network].

PROPAGATION

Cuttings: The woody cuttings root easily; taken in March, they are kept in wet sand until they are planted, as soon as the frost is out of the ground in spring. The semi-herbaceous cuttings, taken in June, also give excellent results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: Cuttings of 20 cm were taken on June 18 and 25, 1991 from parent plants 47 years old that were 1.50 m tall. They were soaked in a solution of 4,000 ppm IBA and 50 % ethanol. They were placed in multipots filled with a medium of perlite and Promix® (1:2 v:v), then misted for 30 seconds every 10 minutes. They were placed in shaded beds on July 29 and August 6 respectively; the rooting rate was 80 %. The seedlings were potted on August 22 in Fertil Pot®. They overwintered in beds protected by coldframes and panels. The rate of overwinter survival was 100 %. At the beginning of May 1992, they were wrapped, then shipped a few days later.

Inclusion in testing network: Young seedlings 9 cm tall were planted at eight trial sites throughout Quebec and northeastern Ontario. Their over-winter survival and their growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

The frequency of winter damage to this species observed over 5 years is presented in Table 1. The details of the main damage that occurred each winter at each of the sites are given below.

Region 1

The first winter, one third of the seedlings died in L'Assomption. However, only frost damage to stem tips occurred the first and last winters on 48 % and 55 % of the seedlings.

In Sainte-Clotilde, 8 % of the seedlings died the third winter. In addition, 8 % of the seedlings showed frost damage to the one-year shoot the first winter and 27 % suffered frost damage to stem tips the last winter.

In Saint-Hyacinthe, 25 %, 10 % and 10 % of the seedlings died the first three winters. Frost damage to stem tips was observed on 10 %, 40 % and 56 % of the seedlings following the first, third and fifth winters.

Region 2

In Sainte-Foy, two seedlings died the first winter. Frost damage to stem tips occurred on 10 %, 11 % and 25 % of the seedlings the first two winters and the last.

In Deschambault, 16 % of the seedlings died the first winter. In the course of the same winter, 5 % and 16 % of the seedlings suffered frost damage to the one-year shoot and to all of their above-ground portion. Stem tips froze every winter on 21 %, 63 %, 45 %, 9 % and 10 % of the seedlings. Mechanical breakage occurred on 5 % and 91 % of the seedlings the last two winters.

In La Pocatière, 37 % of the seedlings suffered frost damage to stem tips the second winter.

Region 3

In Normandin, one seedling died the third winter and there was damage to one seedling the last winter from mechanical breakage.

The first two winters in Kapuskasing, 5 % and 11 % of the seedlings died. In addition, 5 %, 70 %, 50 % and 40 % of bushes had frost damage to stem tips the first four winters. The one-year shoot was affected the last two winters on 40 % and 50 % of the seedlings.

Height and width growth

Figures 1 and 2 show the average height and width of seedlings after five years of trials at each site and region.

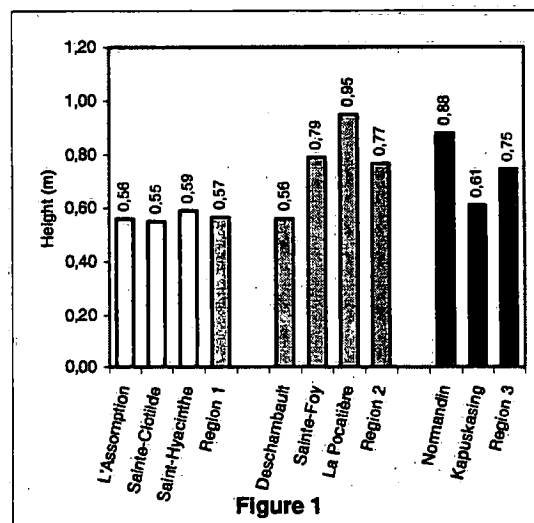


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

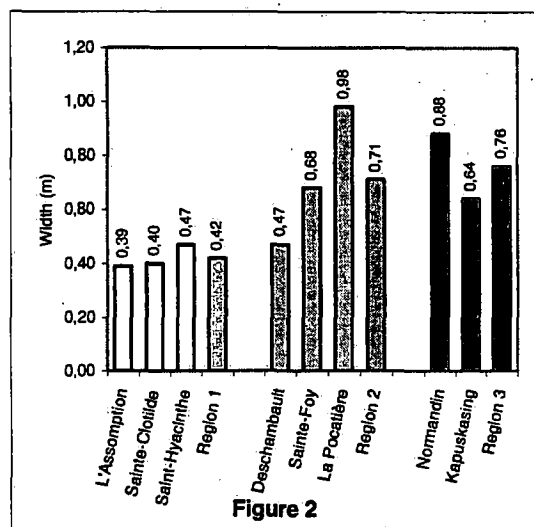


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

In general, the pruning was light at all sites.

Flowering

In region 1, only the seedlings of Saint-Hyacinthe produced flowers the last two years. The flowering began between May 16 and 23 and lasted 12 days. In region 2, flowering occurred later, between May 21 and June 7, and lasted 10 to 24 days. In region 3, the seedlings flowered the second and last years in Normandin and, more sparsely, in Kapuskasing. The period of flowering began between June 2 and 13 and ended from 8 to 14 days later.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and width obtained after each year. Nursery growers will find these tables useful for estimating annual production as well as the number of years needed to obtain a predetermined height and width.

After three years of cultivation, all the seedlings at Saint-Hyacinthe and La Pocatière had reached a height of more than 41 cm, whereas at the Sainte-Foy and Normandin

sites, an additional year was required for all seedlings to achieve a comparable height. At the L'Assomption, Sainte-Clotilde and Deschambault sites, five years was needed. In Kapuskasing, not all seedlings achieved this height category during the trial.

Production of this species is possible in sites of regions 1 and 2 as well as in Normandin. Growth varies considerably from one site to another.

HARDINESS EVALUATION

According to Rehder, this species is hardy to zone 5 of the US system. The trial results showed that seedlings died at almost all sites during the first two or three winters. However, other damage was limited most often to freezing of stem tips.

The first three winters' mortality occurred at sites where the snow comes very late or disappears at the coldest time of the year. The seedlings affected were very likely subjected to too hard a freeze of their roots to allow them to recover the following spring.

In addition, the frequency of damage increases gradually with age in the zone 2a site.

The survival rating of this species may extend as far as zone 2a, if snow covers the seedlings early enough in the season. This species may be used into zone 2b, with the awareness that frost damage to stems may necessitate pruning and that frost damage to roots may occur at sites with no snow during cold periods.

No rating for full expression of ornamental character was obtained at the trial sites.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 28, 31, 32

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Lonicera webbia* Wall. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	73	21						6				27
Sainte-Clotilde	91	5		2				2				9
Saint-Hyacinthe	70	21						9				30
REGION 2												
Deschambault	43	29		1			3	4		20		57
Sainte-Foy	91	8						1				9
La Pocatière	93	7										7
REGION 3												
Normandin	97							1		2		3
Kapuskasing	46	33		18				3				54

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6, 9 and 11 occurred for this species.

Table 2. Breakdown of *Lonicera webbia* Wall. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	86	29	10	0	0	95	20	8	0	0	45	0	0	0	0
021-040	14	71	40	20	22	5	80	67	36	9	55	80	0	20	11
041-060	0	0	50	80	33	0	0	25	54	73	0	20	80	50	56
061-080	0	0	0	0	45	0	0	0	10	18	0	0	20	30	33
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	89	50	0	0	0	63	6	0	0	0	79	0	0	0	0
021-040	11	50	82	36	0	37	94	25	0	0	21	63	0	0	0
041-060	0	0	18	55	82	0	0	75	25	8	0	37	42	0	0
061-080	0	0	0	9	18	0	0	0	67	50	0	0	58	58	0
081-100	-	-	-	-	-	0	0	0	8	42	0	0	0	42	92
101-120	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	90	0	0	0	0	90	32	10	0	0					
021-040	10	30	0	0	0	10	68	70	20	10					
041-060	0	65	83	0	0	0	0	20	20	30					
061-080	0	5	17	73	18	0	0	0	60	50					
081-100	0	0	0	27	82	0	0	0	0	10					
101-120	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Lonicera webbia* Wall. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	40	20	0	100	100	33	18	0	90	20	0	0	0
021-040	0	0	60	80	44	0	0	67	73	55	10	80	90	60	22
041-060	0	0	0	0	56	0	0	0	9	45	0	0	10	40	78
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	95	38	9	0	0	100	33	0	0	0	95	42	0	0	0
021-040	5	62	91	55	27	0	67	92	0	0	5	58	0	0	0
041-060	0	0	0	18	64	0	0	8	33	17	0	0	92	0	0
061-080	0	0	0	27	9	0	0	0	67	83	0	0	8	50	0
081-100	-	-	-	-	-	-	-	-	-	-	0	0	0	50	67
101-120	-	-	-	-	-	-	-	-	-	-	0	0	0	0	33
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	15	0	0	0	100	47	10	0	0					
021-040	0	85	42	0	0	0	53	50	30	10					
041-060	0	0	42	0	0	0	0	40	50	20					
061-080	0	0	16	55	36	0	0	0	20	70					
081-100	0	0	0	45	64	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

MALUS BACCATA

(L.) BORKH. (CONTROL 1991)

The sections Botanical Description, Origin and Distribution, Use and Requirements were previously published in the first factsheet series (publication 02-9227) and in the book *Hardiness and Growth of Woody Ornamental Plants in Quebec*, (95-0070). The section Pathology and Insects was published in volume III of *Hardiness and Growth of Woody Ornamental Plants in Quebec* (VT 008).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: Seeds were harvested in October 1988 from a specimen 45 years old. They were cleaned of their fleshy pericarp and sown in coldframes in early November. They germinated very uniformly in May 1989. The seedlings were pulled up the next fall and heeled in for the winter. In the spring of 1990, 200 seedlings were planted in the nursery. They were pulled up, puddled and heeled in in the fall. On April 30, 1991, they were wrapped in damp peat moss and kept in cold storage at 5 °C until they were shipped in early May.

Inclusion in testing network: Young seedlings 25 to 30 cm tall were planted at eight trial sites across Quebec and northeastern Ontario. Their over-winter survival and their growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Three seedlings out of 21 died following transplantation at the L'Assomption and Deschambault sites, while in Kapuskasing one seedling died.

Winter damage

The frequency of winter damage to this species observed over five years is presented in Table 1. The details of the main damage that occurred each winter at each of the sites are given below.

Region 1

In L'Assomption, 10 % of the seedlings suffered frost damage to the tips of their shoots during the first winter.

In Saint-Hyacinthe, one tree died the first winter.

In Sainte-Clotilde, no damage occurred.

Region 2

In Sainte-Foy, 38 %, 8 % and 8 % of the seedlings showed frost damage to their stem tips after the first, third and fourth winters.

In La Pocatière, frost damage to stem tips was observed the first two winters on 19 % and 5 % of the seedlings.

In Deschambault, no damage occurred during the trial.

Region 3

In Normandin, frost damage to stem tips was observed after the second winter on 40 % of the seedlings. In addition, between 25 % and 57 % of the seedlings suffered mechanical damage four winters out of five.

In Kapuskasing, frost damage to stem tips was recorded after the first three winters on 15 %, 20 % and 67 % of the seedlings. The one-year shoot was affected on 5 % and 15 % of the seedlings the first two winters, whereas one tree showed damage to old wood after the first winter.

Height and trunk diameter growth

Figures 1 and 2 show the seedlings' average height and trunk diameter after five years of trials at each site and region.

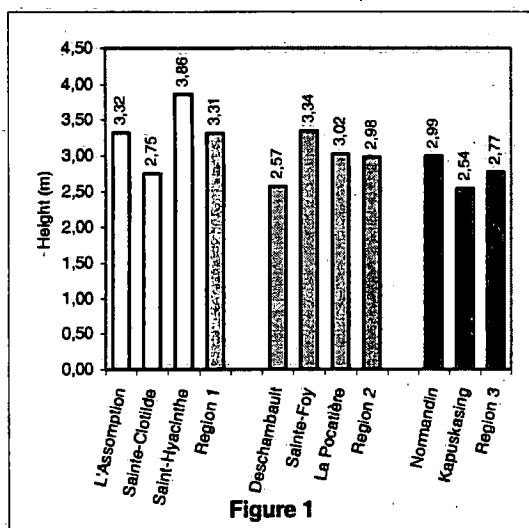


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

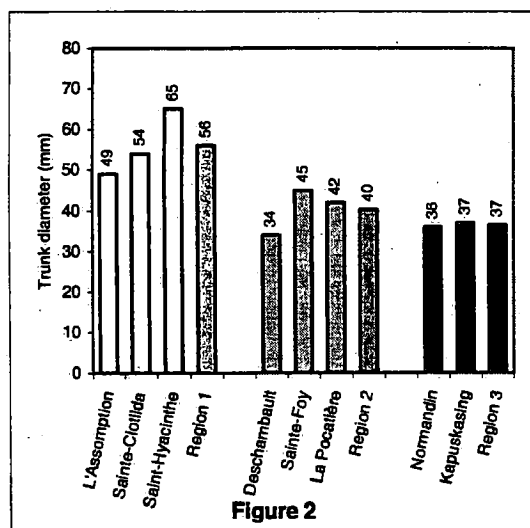


Figure 2. Mean tree-trunk diameter at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning was necessary, apart from pruning for shape.

Flowering

Flowering if any occurred during the last two years. In region 1, a few seedlings flowered at the L'Assomption and Saint-Hyacinthe sites; the first flowers appeared in mid-May (May 15 to 23) for a period of 8 to 13 days. At all

other sites, a few seedlings produced flowers the first week of June for a short (8- to 11-day) period.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site for the final trunk height and diameter obtained after each year. Nursery growers will find these tables useful for estimating annual production as well as the number of years necessary to obtain a given tree-trunk height and diameter.

After three years of cultivation, 67 % to 75 % of the seedlings had reached a height of between 2 and 3 m at the Sainte-Clotilde, Saint-Hyacinthe, Sainte-Foy, La Pocatière and Normandin sites. A fourth year was needed to obtain seedlings of similar size at the other sites.

In comparison to other lots from the same seed tree that were planted in previous years, the seedlings in this trial were smaller at the time of planting and environmental conditions may have been less favourable to their growth.

HARDINESS EVALUATION

This species has been tested repeatedly at REPLOQ over the years and serves as a control. Mortality is exceptional and random. The survival rating is constant in zone 2 and even zone 1b.

The full ornamental utility rating is climatic zone 2b and the use rating extends as far as zone 2a.

BIBLIOGRAPHIC REFERENCES

2, 7, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 62, 65

WRITTEN BY

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Michel Auger, Tech.

Table 1. Frequency of winter damage observed on *Malus baccata* (L.) Borkh. (Control 1991) from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	98	2										2
Sainte-Clotilde	100											0
Saint-Hyacinthe*	99							1				1
REGION 2												
Deschambault	100											0
Sainte-Foy	89	11										11
La Pocatière	91	5								4		9
REGION 3												
Normandin	61	8						2		29		39
Kapuskasing	72	20		4	1					3		28

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period.

No damage of type 3, 6, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Malus baccata* (L.) Borkh. (Control 1991) plants by marketable height category from 1991 to 1995

REGION 1																
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*					
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95	
001-100	100	28	0	0	0	100	35	0	0	0	-	0	0	0	0	
101-200	0	72	58	0	0	0	65	25	17	17	-	78	33	0	0	
201-300	0	0	42	91	16	0	0	75	66	41	-	22	67	33	0	
301-400	0	0	0	9	84	0	0	0	17	42	-	0	0	67	66	
401-500	-	-	-	-	-	-	-	-	-	-	-	0	0	0	34	
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
REGION 2																
Height (cm)	Deschambault					Sainte-Foy					La Pocatière					
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95	
001-100	100	28	8	0	0	86	0	0	0	0	96	19	0	0	8	
101-200	0	72	75	25	16	14	91	33	8	0	4	81	33	8	0	
201-300	0	0	17	75	59	0	9	58	58	33	0	0	67	50	25	
301-400	0	0	0	0	25	0	0	9	34	58	0	0	0	42	67	
401-500	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-	
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
REGION 3																
Height (cm)	Normandin					Kapuskaing										
	91	92	93	94	95	91	92	93	94	95						
001-100	29	5	0	0	0	90	20	0	0	0						
101-200	71	57	33	25	17	10	80	83	33	0						
201-300	0	38	67	50	25	0	0	17	67	88						
301-400	0	0	0	25	58	0	0	0	0	12						
401-500	-	-	-	-	-	-	-	-	-	-						
501-600	-	-	-	-	-	-	-	-	-	-						

*Datan were collected since 1992.

Table 3. Breakdown of *Malus baccata* (L.) Borkh. (Control 1991) plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	11	0	0	0	100	5	0	0	0	-	-	-	0	0
011-020	0	67	0	0	0	0	80	0	0	0	-	-	-	0	0
021-030	0	22	50	8	0	0	15	25	8	0	-	-	-	0	0
031-040	0	0	42	50	17	0	0	67	33	17	-	-	25	8	0
041-050	0	0	8	42	25	0	0	8	42	25	-	-	58	17	17
051-060	0	0	0	0	58	0	0	0	17	25	-	-	17	33	8
061-070	0	0	0	0	0	0	0	0	0	33	-	-	0	42	50
071-080	-	-	-	-	-	-	-	-	-	-	-	-	0	0	8
081-090	-	-	-	-	-	-	-	-	-	-	-	-	0	0	17

Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	100	33	0	0	0	33	0	0	0	0	100	5	0	0	8
011-020	0	67	50	8	8	67	24	0	0	0	0	95	8	8	0
021-030	0	0	50	42	33	0	71	33	16	8	0	0	92	8	8
031-040	0	0	0	50	42	0	5	50	42	17	0	0	0	67	0
041-050	0	0	0	0	17	0	0	17	17	50	0	0	0	17	67
051-060	-	-	-	-	-	0	0	0	25	8	0	0	0	0	17
061-070	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-
071-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
081-090	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Trunk diameter (mm)	REGION 3									
	Normandin					Kapuskasing				
	91	92	93	94	95	91	92	93	94	95
001-010	48	10	0	0	17	75	25	0	0	0
011-020	52	76	42	8	0	25	75	75	8	0
021-030	0	14	50	42	8	0	0	25	67	13
031-040	0	0	8	25	33	0	0	0	25	62
041-050	0	0	0	25	17	0	0	0	0	25
051-060	0	0	0	0	25	-	-	-	-	-
061-070	-	-	-	-	-	-	-	-	-	-
071-080	-	-	-	-	-	-	-	-	-	-
081-090	-	-	-	-	-	-	-	-	-	-

*Data were collected since 1993.

MALUS BACCATA

(L.) BORKH. (CONTROL 1992)

The sections Botanical Description, Origin and Distribution, Use and Requirements were previously published in the first factsheet series (publication 02-9227) and in the book *Hardiness and Growth of Woody Ornamental Plants in Quebec*, (95-0070). The section Pathology and Insects was published in volume III of *Hardiness and Growth of Woody Ornamental Plants in Quebec* (VT 008).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: The fruits were harvested in October 1989 from healthy parent plants about forty years old. The seeds were cleaned of their fleshy pericarp and sown in outdoor coldframes at the beginning of November. They germinated uniformly in May 1990. The seedlings were pulled up in the fall of 1991 and heeled in. They were wrapped and shipped on May 5, 1992.

Inclusion in test network: Young seedlings 45 cm tall were planted in seven trial sites across Quebec and northeastern Ontario. Their over-winter survival and their growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

The frequency of winter damage to this species observed over 5 years is presented in Table 1. The details of the main damage that occurred each winter at each of the sites are given below.

Region 1

Damage was infrequent at sites in this region.

In L'Assomption, damage occurred during the first winter only; one seedling died, two seedlings suffered frost damage to stem tips and one tree showed damage from mechanical breakage.

In Sainte-Clotilde, one seedling died the second winter. No further damage occurred.

In Saint-Hyacinthe, only rodent damage occurred the last winter.

Region 2

In Sainte-Foy, 14 % and 19 % of the seedlings suffered frost damage to stem tips the first two winters. In addition, 25 % of trees suffered damage from mechanical breakage the following winter.

No damage occurred in La Pocatière.

Region 3

In Normandin, one seedling died the fourth winter. The first winter, 5 % of the seedlings suffered frost damage to the above-ground portion (above the snow cover). The following winter, 10 % of trees sustained damage to the stem tips and 10 % had damage from mechanical breakage the last winter.

In Kapuskasing, two seedlings died the first and third winters. In addition, 10 % and 47 % of trees had frozen stem tips the first two winters. Frost damage to the one-year shoot was observed on 21 % of the seedlings the second winter and one seedling showed damage from mechanical breakage. No damage occurred the last two winters.

Height and trunk diameter growth

Figures 1 and 2 show the average height and trunk diameter of seedlings after five years of trials at each site and region.

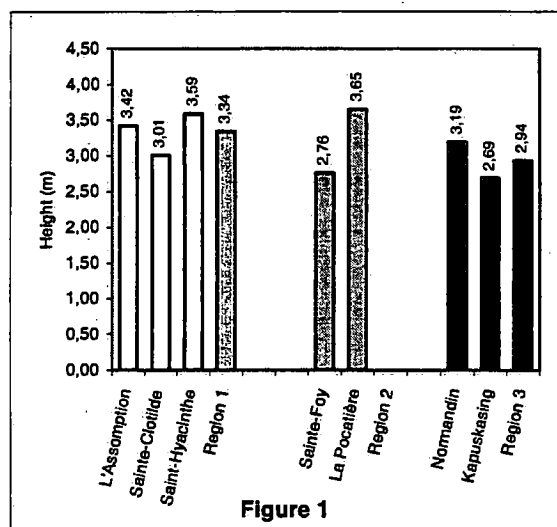


Figure 1

Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

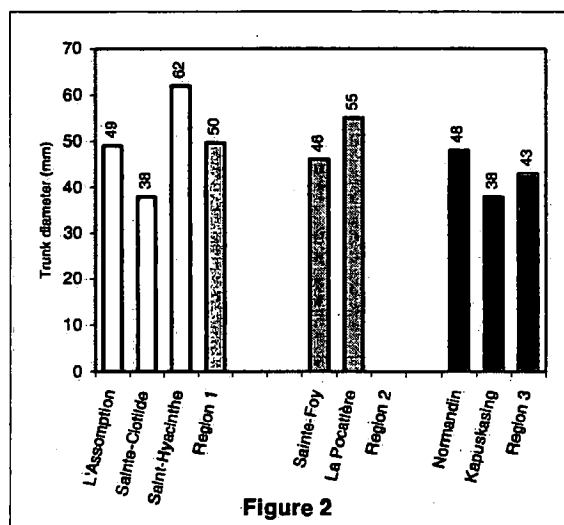


Figure 2

Figure 2. Mean tree-trunk diameter at trial's end at each of the eight sites and three regions

Tree-trunk diameters were particularly homogeneous at sites in regions 2 and 3.

Effect of pruning

No pruning was done during the trial.

Flowering

Flowering if any occurred in the last two years. In region 1, a few seedlings flowered at the L'Assomption and Saint-

Hyacinthe sites and the first flowers appeared in mid-May (May 15 to 23) for a period of 8 to 13 days. At all other sites, a few seedlings produced flowers in the first week of June, for a short (8- to 11-day) period.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site based on the average tree-trunk height and diameter at the end of each season. Nursery growers will find these tables useful for estimating annual production as well as the number of years necessary to obtain a given tree-trunk height and diameter.

After two years of production, nearly 80 % of trees in L'Assomption, Saint-Hyacinthe and La Pocatière had reached a trunk diameter of between 21 and 40 mm, which compares to 71 % and 40 % of trees in Sainte-Foy and Normandin. It took another year for the Normandin seedlings to achieve a comparable diameter, and two more years for the Kapuskasing seedlings.

After two years of cultivation, all the trees measured more than 1.0 m in height.

HARDINESS EVALUATION

Just as in previous trials, the *Malus baccata* seedlings showed very little damage and are very frost-resistant. Survival and use ratings are set at zone 2a, but it should be noted that this species may be used without risk of serious damage throughout Quebec and northeastern Ontario, even in zone 1b.

This species has shown its full ornamental potential into zone 4a.

BIBLIOGRAPHIC REFERENCES

3, 7, 62, 64, 66

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Malus baccata* (L.) Borkh. (Control 1992) from 1993 to 1997

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	96	2						1		1		4
Sainte-Clotilde	99							1				1
Saint-Hyacinthe	80										20	20
REGION 2												
Deschambault	-											-
Sainte-Foy	88	7								5		12
La Pocatière	100											0
REGION 3												
Normandin	93	2				1		2		2		7
Kapuskasing	81	11		4				3		1		19

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 7 and 9 occurred for this species.

Table 2. Breakdown of *Malus baccata* (L.) Borkh. (Control 1992) plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	47	6	0	0	0	95	33	0	0	0	65	5	0	0	0
101-200	53	77	67	0	0	5	67	75	8	8	35	80	8	0	0
201-300	0	17	33	67	25	0	0	25	92	33	0	15	92	33	8
301-400	0	0	0	33	75	0	0	0	0	59	0	0	0	67	75
401-500	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17

REGION 2										
Height (cm)	Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96
001-100	43	0	17	0	17	29	0	0	0	0
101-200	57	86	17	25	8	71	62	0	0	0
201-300	0	14	66	42	17	0	38	83	33	17
301-400	0	0	0	33	58	0	0	17	67	50
401-500	-	-	-	-	-	0	0	0	0	33

REGION 3										
Height (cm)	Normandin					Kapuskasing				
	92	93	94	95	96	92	93	94	95	96
001-100	20	0	0	0	0	100	11	8	0	0
101-200	80	65	9	0	0	0	89	75	9	0
201-300	0	35	91	55	40	0	0	17	91	82
301-400	0	0	0	45	50	0	0	0	0	18
401-500	0	0	0	0	10	-	-	-	-	-

Table 3. Breakdown of *Malus baccata* (L.) Borkh. (Control 1992) plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	95	22	0	0	0	100	71	17	0	0	100	15	0	0	0
021-040	0	78	100	50	25	0	29	83	83	75	0	85	33	8	0
041-060	5	0	0	50	67	0	0	0	17	25	0	0	67	75	50
061-080	0	0	0	0	8	-	-	-	-	-	0	0	0	17	42
081-100	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8

Trunk diameter (mm)	REGION 2									
	Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96
001-020	100	29	0	0	0	100	19	0	0	0
021-040	0	71	92	50	25	0	81	58	17	0
041-060	0	0	8	50	67	0	0	42	83	67
061-080	0	0	0	0	8	0	0	0	0	33
081-100	-	-	-	-	-	-	-	-	-	-

Trunk diameter (mm)	REGION 3									
	Normandin					Kapusksing				
	92	93	94	95	96	92	93	94	95	96
001-020	100	60	9	0	0	100	100	75	9	0
021-040	0	40	82	45	20	0	0	25	91	73
041-060	0	0	9	55	60	0	0	0	0	27
061-080	0	0	0	0	20	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-

PHILADELPHUS CORONARIUS

'AUREUS'

Family:	Saxifragaceae
English name:	Golden Mock-Orange
French name:	Séringat doré
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This compact shrub of erect habit is not as tall as the species form. It can grow to 1.5 m tall and over 1.0 m wide.

The brown bark is loosely attached, peeling off in fine strips. The branches are numerous and very straight.

The small glabrous buds are inconspicuous, hidden at the base of the petiole. The opposite leaves, oval and entire in shape, are bright yellow when young and turn green as they mature. The remotely denticulate leaves are 4-8 cm long and 2-4 cm wide. The dense foliage has a slight fragrance.

The sparse white flowers are borne in small terminal racemes of 5-7 blooms, each 2-3 cm across, and are slightly fragrant. Flowering occurs in June. The petals are narrowly obovate and the styles are often united to or beyond the middle.

The roots are numerous.

ORIGIN AND DISTRIBUTION

The species is native to East Asia.

USE

Ornamental: Mainly grown for its decorative foliage, this shrub is particularly suited to small, semi-shady gardens and can also be used in hedges.

DISEASES AND INSECTS

To our knowledge, the cultivar is not attacked by any major disease or insect pest.

REQUIREMENTS

This shrub thrives in a partly sunny location; too much shade dulls the colour of the foliage. Undemanding about soil, it prefers a moist location although it does tolerate drought. Annual pruning is done after flowering; renewal pruning should be done every five years.

PROPAGATION

Cuttings: Cuttings are taken after the leaves are shed, when the twigs are well lignified. Cuttings can be planted immediately in a cold frame or stored during the winter and pricked out in the nursery in spring. Semiripe cuttings, taken in late June, have a high success rate.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 512 cuttings (12 cm) were taken on June 26, 1989, from roughly twenty-year-old parent plants. They were dipped for five seconds in a 4,000 ppm-IBA/50 % ethanol solution and then in a fungicide solution (Benomyl-Captan®). They were planted in a peat-perlite substrate (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 80 % after 49 days. The seedlings were potted up in Fertil Pots® in a peat-perlite mixture (3:2; v:v) and treated weekly with a soluble fertilizer (20-20-20) until mid-September. They were kept in an unheated greenhouse until mid-November, when they were put in the cold store at 0 °C in plastic bags perforated with a hatpin. In May 1990, 315 seedlings were transplanted to the nursery where they were grown on until May 1991. They were then dug up, puddled,

wrapped and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Young seedlings pruned to 10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, two plants died the second and third winters. During the first three winters, 100 %, 90 % and 80 % of plants suffered frost damage to the branch tips. No other damage occurred subsequently.

At Sainte-Clotilde, 25 %, 25 % and 11 % of seedlings died the first three winters. The third winter, 44 % of plants had frost damage to the previous year's shoots. The branch tips were affected on 44 % and 20 % of shrubs the third and fourth winters.

A single seedling survived at Saint-Hyacinthe, with all others dying over the first four winters in proportions of 32 %, 23 %, 57 % and 33 %. The first three winters, 58 %, 38 % and 42 % of plants suffered frost damage to the branch tips. In addition, 31 % of the shrubs had damage to the one-year-old shoots the second winter.

Region 2

At Sainte-Foy, two seedlings died the first winter, and another three the second winter. The first four winters, 89 %, 35 %, 13 % and 75 % of plants suffered frost damage to the branch tips. The one-year-old shoots were damaged

in 12 % of shrubs the second winter. No damage occurred the last winter.

The first three winters at Deschambault, 11 %, 6 % and 9 % of plants died while over half of the plants had damage to the branch tips. The second and third winters, 25 % and 27 % of shrubs had frost damage to the one-year-old shoots. In addition, the old wood was damaged in 30 % and 70 % of shrubs the last two winters.

At La Pocatière, one seedling died the second winter. Frost damage to the branch tips was observed in 100 % and 36 % of seedlings the first two winters. The third and fourth winters, 44 % and 22 % of plants suffered damage to the one-year-old shoots, and 22 % and 11 % of plants had damage to the old wood. No damage occurred the last winter.

Region 3

All seedlings died during the first three winters at Normandin.

At Kapuskasing, all the plants died over the first four winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

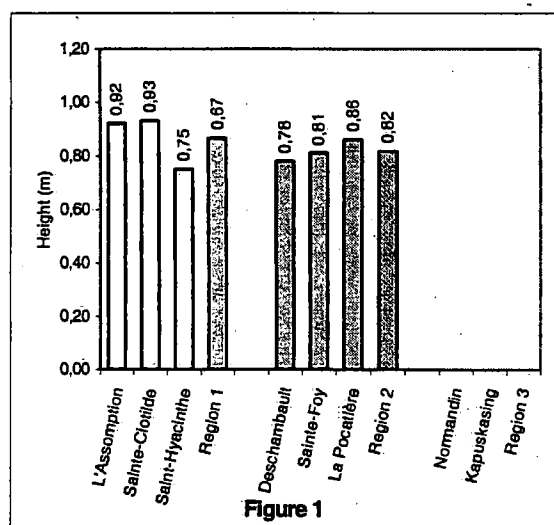


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

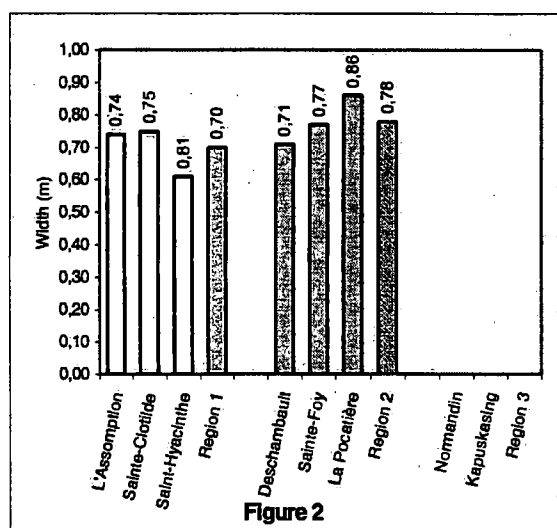


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

At Sainte-Clotilde, no pruning was done. At the other sites, the shrubs were cut back by one third to deal with winter damage.

Flowering

At L'Assomption, flowering lasted 7-12 days and the first flowers appeared around June 15. Flowering occurred at all

region 2 sites at the same time, between June 20 and 26. The mean duration of flowering was 10-16 days, depending on the year. No flowering occurred in region 3.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

The plants evaluated came from cuttings taken from a healthy parent plant over 20 years old with demonstrated hardiness in zone 4b. The very high mortality observed at all sites during the first three winters is puzzling. Very few seedlings were able to get established and grow normally during the five-year trials. In addition, a high degree of heterogeneity was observed among the shrubs at the same site in terms of annual growth. The reasons for these results may be linked to the age of the parent plant, poor root system development in the cuttings, degeneration (shown by necrosis of the foliage and stems) or the parent plant's poor potential.

In any case, this cultivar is produced commercially in hardiness zones 4 and 5. The results of the trial highlight the importance of high-quality parent plants and seedlings.

HARDINESS EVALUATION

According to the literature, this cultivar is hardy to zone 3. Since all the plants at Normandin and Kapuskasing achieved little growth and eventually died during the trial, it seems obvious that the cultivar can survive only in warmer zones. However, the mortality observed at the other sites occurred only during the first winters and in the weakest plants. The shrubs that did survive had good growth. Therefore, the cultivar can be considered hardy to zone 4a in terms of survival and use.

The cultivar did not achieve its full ornamental potential at the sites tested.

BIBLIOGRAPHIC REFERENCES

2, 7, 21, 25, 33, 34, 35, 39, 67

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Michel Auger, Tech.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Philadelphus coronarius* 'Aureus' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	40	54						6				60
Sainte-Clotilde	66	13		9				12				34
Saint-Hyacinthe	37	28		6				29				63
REGION 2												
Deschambault	31	34		10	20			5				69
Sainte-Foy	50	42		2				6				50
La Pocatière	51	27		13	7			2				49
REGION 3												
Normandin	3	18		3				76				97
Kapuskasing	0						39	61				100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

^aDamage was evaluated over a four-year period.

No damage of type 3, 6, 9, 10 and 11 occurred for this cultivar.

Table 2. Breakdown of *Philadelphus coronarius* 'Aureus' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-025	80	0	9	0	0	18	33	11	0	0	-	0	0	0	0
026-050	20	40	18	0	0	82	67	22	0	0	-	13	0	0	0
051-075	0	60	64	62	25	0	0	56	63	20	-	62	15	33	50
076-100	0	0	9	38	50	0	0	11	37	60	-	25	85	67	50
101-125	0	0	0	0	13	0	0	0	0	20	-	-	-	-	-
126-150	0	0	0	0	12	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-025	39	0	0	0	0	37	5	0	12	0	50	7	0	0	0
026-050	61	50	27	20	30	63	53	13	0	13	43	93	0	0	0
051-075	0	50	63	60	20	0	42	37	25	12	7	0	78	22	22
076-100	0	0	10	10	30	0	0	50	63	62	0	0	22	78	67
101-125	0	0	0	10	20	0	0	0	0	13	0	0	0	0	11
126-150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin**					Kapuskasing**									
	91	92	93	94	95	91	92	93	94	95					
001-025	27	33	0	-	-	100	33	67	100	-					
026-050	73	67	0	-	-	0	67	33	0	-					
051-075	0	0	100	-	-	-	-	-	-	-					
076-100	-	-	-	-	-	-	-	-	-	-					
101-125	-	-	-	-	-	-	-	-	-	-					
126-150	-	-	-	-	-	-	-	-	-	-					

*At Saint-Hyacinthe, data were collected on four years only.

**At Normandin, all plants were died after three years and at Kapuskasing, after four years.

Table 3. Breakdown of *Philadelphus coronarius* 'Aureus' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	15	36	0	0	100	100	11	0	0	-	37	0	0	0
041-080	0	85	64	100	63	0	0	89	100	80	-	63	14	100	100
081-120	0	0	0	0	37	0	0	0	0	20	-	0	86	0	0
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	83	13	27	10	10	11	23	13	12	12	100	57	0	0	0
041-080	17	87	64	70	60	89	77	75	63	50	0	43	67	34	34
081-120	0	0	9	20	30	0	0	12	25	38	0	0	33	55	66
121-160	-	-	-	-	-	-	-	-	-	-	0	0	0	11	0
REGION 3															
Width (cm)	Normandin**					Kapuskasing**									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	83	100	-	-	100	67	67	100	-					
041-080	0	17	0	-	-	0	33	33	0	-					
081-120	-	-	-	-	-	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

*At Saint-Hyacinthe, data were collected on four years only.

**At Normandin, all plants were died after three years and at Kapuskasing, after four years.

PICEA ABIES 'NIDIFORMIS'

Family:	Pinaceae
English name:	Bird's Nest Spruce, Nidiformis Norway Spruce
French name:	Épinette de Norvège 'Nidiformis'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This dwarf shrub of bushy, rounded, spreading habit can reach 0.6 m high and 2.0 m wide. Its flattened top, with a depression in the centre, is reminiscent of a bird's nest or goblet, hence the cultivar's name.

The inconspicuous trunk has scaly bark.

The main branches are semi-erect and curve outwards. The spindly but strong twigs have tiny sharp, scaly conical buds.

The short, sparse needles turn dark green in fall. The dense foliage is particularly attractive in spring when the buds burst forth in bright fresh green.

This cultivar does not produce cones.

It is shallow rooted.

ORIGIN AND DISTRIBUTION

This cultivar, which grows in the mountains of Germany, was discovered in 1907.

USE

Ornamental: This small shrub is used with other conifers, shrubs and perennials, as a specimen plant or in mass plantings.

REQUIREMENTS

This cultivar requires sun, but dislikes extreme heat. It prefers sandy loam soil and high humidity. It is quite

hardy, but it is susceptible to, and should be protected from, the prevailing winds. The cultivar is very slow growing, reaching only 25 cm tall and 70 cm wide in ten years.

DISEASES AND INSECTS

This cultivar has few disease or insect problems. However, cytospora canker, caused by *Cytospora kunzei*, often affects Norway Spruce.

PROPAGATION

Cuttings: Cuttings from dwarf parents are fairly successful. Cuttings are taken from two-year-old wood, since one-year-old wood is too small. 'Nidiformis' takes a year to root. All cuttings must be replanted in a heated greenhouse.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 440 cuttings (10 cm long) were taken on June 25, 1990 from roughly ten-year-old parent plants. They were dipped for 5 seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed in tap water. They were dipped in a Benomyl-Captan® based fungicide solution, planted in peat moss and perlite (2:3; v:v) and put under a mist unit (Mist-A-Matic®). The rooting rate was 75 % after 130 days. Misting was discontinued in early October and the seedlings were treated with a soluble fertilizer (20-20-20, 200 ppm N) on two separate occasions a week apart. In November, they were taken out of their rooting containers and put in the cold store at 0 °C in plastic bags perforated with a hat pin. In May 1991, the seedlings were potted up in Fertil Pot® in peat moss and perlite (3:2; v:v) and put in a tunnel greenhouse for roughly a month. They were then put outside in cold frames provided with light shade. Seedlings were treated

weekly with a soluble fertilizer (20-20-20, 200 ppm N) until mid-September. In November, they were moved to the cold store at 0 °C. In early May 1992, they were wrapped and placed in the cold store at 4 °C, to await shipping a few days later.

Inclusion in testing network: Seedlings 7 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one plant had foliage browning the first winter and another suffered frost damage to the branch tips during the last winter.

At Sainte-Clotilde, 5 % and 33 % of shrubs died during the first two winters. No other damage occurred.

At Saint-Hyacinthe, one plant suffered foliage browning during the second winter.

Region 2

No damage occurred at Deschambault and La Pocatière.

One seedling died the first winter at Sainte-Foy. No other damage occurred.

Region 3

One seedling died the first winter at Normandin. The only subsequent damage occurred in the last two winters, consisting of mechanical breakage in 8 % and 33 % of plants.

At Kapuskasing, one seedling died the second winter. Frost damage to the branch tips occurred in 10 %, 90 % and 10 % of shrubs during the first, third and last winters. The one-year-old shoots were affected on one shrub during the fourth winter. The first winter, 24 % of the plants suffered foliage browning.

Height and width growth

Figures 1 and 2 show the mean height and width of the shrubs after five years of testing at each site in the three regions.

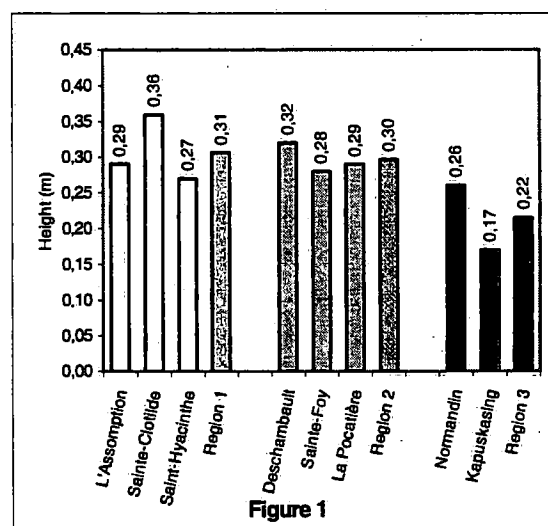


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

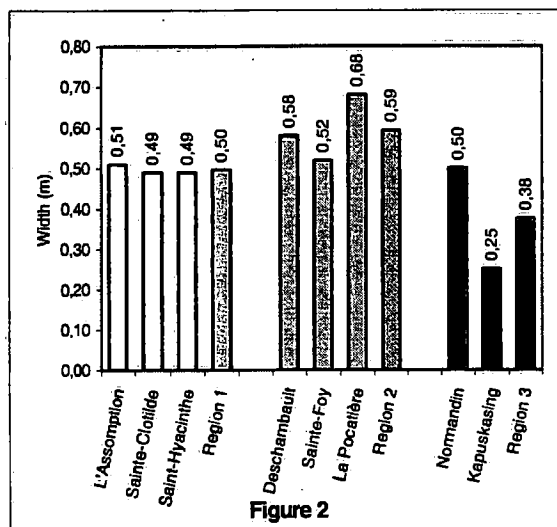


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Height growth was remarkably similar at all sites, except Kapuskasing, where it was slower, with plants reaching a height of barely 17 cm by the end of the trial.

By the second year, the shrubs were already wider than they were tall.

Effect of pruning

No pruning was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

This cultivar, which is particularly slow growing, makes an ideal specimen for collections. It can be produced in all zones as long as soil and winter protection requirements are met. Adequate snow cover reduces damage from foliage browning.

Growth was similar at all sites except Kapuskasing, where it was slower.

HARDINESS EVALUATION

In the literature, the cultivar is placed in either the same zone as the species (zone 2b) or, according to some authors, zone 4. The test results show that this spruce can survive in hardiness zones 2 to 5, since the low height reached in the coldest areas allows shrubs to benefit from the snow cover, ensuring protection against even the severe cold found in zone 2.

The cultivar can be used in zones 2 to 5.

Full ornamental potential was achieved in zones 4 and 5 at several sites tested.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 9, 17, 28, 31, 32, 33, 36, 39, 73

WRITTEN BY

Claude Richer, Agr.

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Table 1. Frequency of winter damage observed on *Picea abies* 'Nidiformis' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	5	6	7	8	10	11	14	
REGION 1											
L'Assomption	97	2								1	3
Sainte-Clotilde	87						7			6	13
Saint-Hyacinthe	99									1	1
REGION 2											
Deschambault	100										0
Sainte-Foy	99						1				1
La Pocatière	100										0
REGION 3											
Normandin	91						1	8			9
Kapuskasing	71	26	1				1			1	29

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Picea abies* 'Nidiformis' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-010	67	14	0	0	0	100	0	0	0	0	86	5	5	0	0
011-020	33	86	58	25	0	0	100	25	0	0	14	95	67	33	8
021-030	0	0	42	75	67	0	0	75	100	10	0	0	28	67	84
031-040	0	0	0	0	33	0	0	0	0	90	0	0	0	0	8
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-010	38	0	0	0	0	95	0	0	0	0	81	0	0	0	0
011-020	62	100	58	0	0	5	100	100	8	0	19	100	100	17	0
021-030	0	0	42	100	25	0	0	0	92	100	0	0	0	83	83
031-040	0	0	0	0	75	-	-	-	-	-	0	0	0	0	17
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-010	100	0	0	0	0	100	33	5	0	0					
011-020	0	100	75	83	8	0	67	95	100	85					
021-030	0	0	25	17	92	0	0	0	0	15					
031-040	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Picea abies* 'Nidiformis' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	95	33	0	0	100	72	8	0	0	100	100	29	8	0
021-040	0	5	67	75	8	0	28	92	100	20	0	0	71	50	8
041-060	0	0	0	25	75	0	0	0	0	80	0	0	0	42	92
061-080	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	19	0	0	0	100	95	8	0	0	100	90	0	0	0
021-040	0	81	100	33	0	0	5	92	25	0	0	10	100	100	0
041-060	0	0	0	67	67	0	0	0	75	100	-	-	-	-	-
061-080	0	0	0	0	33	-	-	-	-	-	0	0	0	0	100
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	90	0	0	0	100	100	75	70	30					
021-040	0	10	100	42	17	0	0	25	30	70					
041-060	0	0	0	58	83	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					

PINUS ARISTATA ENGELM.

Family:	Pinaceae
English name:	Bristle Cone Pine
French name:	Pin à cône épineux
Category:	Evergreen plant
Subdivision:	Small tree

BOTANICAL DESCRIPTION

This species, with its irregular bushy habit, can reach 2 m tall and 15 m wide under optimal conditions.

The spreading branches, which curve upwards at the tips, bear a number of short reddish twigs. The young reddish-brown shoots are pubescent.

The bark is very smooth.

The abundant needles grow very tightly together, forming dense clusters. The needles are short, 2-4 cm long, and arranged in bundles of five. Bluish green in colour, they are dusted with whitish resin. The resin exudation gives the shrub an overall blue-green effect.

The prickly, aristate cones are 9 cm long. They are covered with slightly spiny scales and mature in fall.

The tree is intermediately rooted.

ORIGIN AND DISTRIBUTION

This species is native to the southwestern United States (Colorado, Arizona and New Mexico). Specimens over 2,000 years old have been discovered in the White Mountains of California. Another tree, 4,900 years old, was found in Nevada; this is probably the oldest living plant on earth. This pine grows well throughout Europe, except in warm Mediterranean areas.

USE

Ornamental: The dwarf version of this tree is a remarkable specimen. It is an excellent plant for rock gardens and

container gardens. It can also be used for bonsai, but is not recommended for novice gardeners.

REQUIREMENTS

This species requires full sun. It thrives in soil of any pH, and prefers poor, rocky soils. It is known to be highly drought resistant, and does not thrive in moist areas. Although quite hardy, it will grow better in a site sheltered from the prevailing winds and winter sun. Very slow growing, it rarely grows taller than 3-6 m in gardens even after 10 years. Its annual growth is roughly 5 cm.

DISEASES AND INSECTS

This species has few known disease or insect problems; after all, it has survived for thousands of years.

However, the genus is affected by a number of insects such as white pine weevil, scale insects, spittlebugs and the European pine shoot moth.

PROPAGATION

Seeds: Propagation is done by seed. The cones mature in September or October. Seedlings need good soil and shelter from the wind to survive the winter.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Lawyer's Nurseries, Colorado (United States)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds, received on November 4, 1987, were planted 10 mm deep in Promix® and sand (1:2; v:v) and shaded with a cloth (63 %). Sprouting occurred on May 10, 1988. On August 29, 1989, 600 seedlings were potted up in 10-cm containers, treated with liquid fertilizer (10-52-10) at the recommended rate and put in beds. During the growing season, they were treated every other week with soluble fertilizer (20-20-20, 200 ppm

N). They overwintered in beds without winter protection; losses of 20 % were observed the following spring. The seedlings were grown in pots until April 1992; mortality was low during both winters. They were then wrapped, puddled and stored in a cellar to await shipment.

Inclusion in testing network: Seedlings 6 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 5 %, 9 %, 18 % and 11 % of the plants died the first winter and last three winters. Foliage browning was observed in 6 % and 22 % of trees during the second and fifth winters. One plant suffered damage due to the weight of the snow during the last winter.

At Sainte-Clotilde, 38 %, 8 % and 17 % of trees died the second, third and fifth winters. Foliage browning occurred in one tree during the fourth winter.

At Saint-Hyacinthe, all the trees died during the first three winters, 75 % of them during the first winter alone.

Region 2

At Sainte-Foy, the only damage that occurred was foliage browning in 15 % of plants during the last winter.

At Deschambault, all the seedlings in the third replication died the first winter. Foliage browning occurred in 7 % and 25 % of plants the second and fourth winters.

No damage was observed at La Pocatière.

Region 3

At Normandin, 50 % of seedlings died the first winter and 25 % and 17 % of the remaining plants succumbed during the last two winters. The only other damage observed was foliage browning, which occurred on 50 % and 67 % of the surviving plants during the last two winters.

At Kapuskasing, all the trees were dead by the end of the third winter; a full 60 % of seedlings died the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years of testing at each site in the three regions.

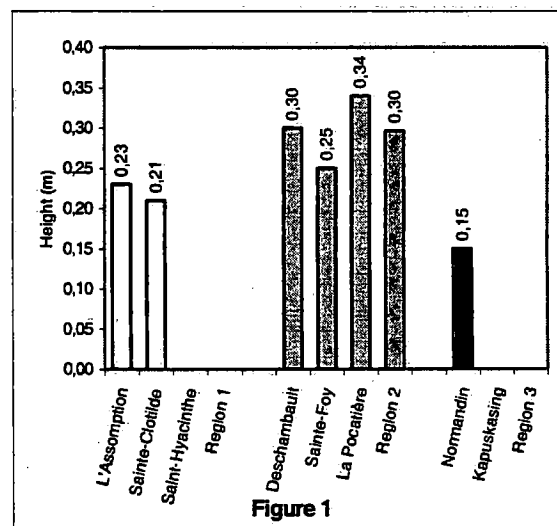


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

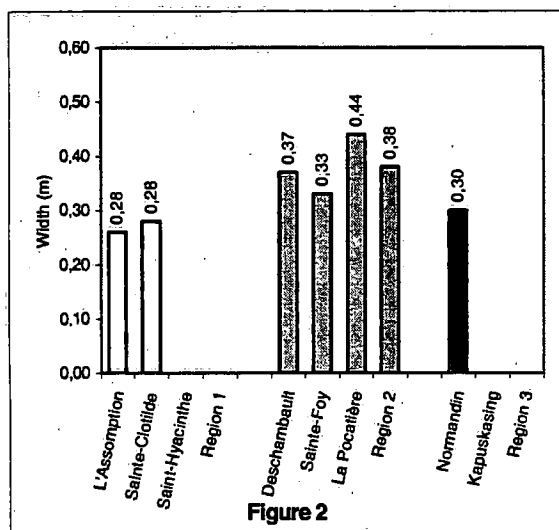


Figure 2. Mean width of trees at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

This species, which is particularly slow growing, is an ideal specimen for collections. It can be produced in all zones, as long as soil and winter protection requirements are met.

Commercial production is limited to the Quebec City region, with its abundant and continuous snow cover. Seedlings that were poorly rooted suffered desiccation due to frost heaving at sites in the warmest zone. Several seedlings died before the first evaluations in spring.

HARDINESS EVALUATION

The species is considered to be hardy to USDA zones 3a to 5. The test results show that this pine is hardy in zones 4 and 5, but needs adequate winter protection the first few years. Some trees survived in zone 2b, but the gradual mortality seen reflects a lack of vigour and tolerance of severe cold.

The species can be used as far as zones 4 and 5, even though seedlings survived in zone 2b.

Full ornamental potential was achieved in zone 4a, at La Pocatière.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 17, 27, 28, 31, 33, 35, 38, 73

WRITTEN BY

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Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Pinus aristata* Engelm. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	5	6	7	8	10	11	14	
1											
REGION 1											
L'Assomption	81						11	2		6	19
Sainte-Clotilde	86						13			1	14
Saint-Hyacinthe	13						86			1	87
REGION 2											
Deschambault	87						7			6	13
Sainte-Foy	95									5	5
La Pocatière	100										
REGION 3											
Normandin	59						18			23	41
Kapuskasing	35						58			7	65

^a Key:

- 1 = no damage
- 2 = damage to the tip of the previous year's shoot
- 3 = frost damage on the flower buds
- 4 = previous year's shoot affected
- 5 = old wood affected
- 6 = dead down to the level of snow cover

- 7 = dead down to the ground surface
- 8 = dead
- 9 = sunscald, trunk spitting
- 10 = mechanical breakage related to weather conditions
- 11 = damage by rodents
- 14 = partial browning of the foliage

No damage of type 2, 3, 4, 5, 6, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Pinus aristata* Engelm. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-010	95	66	25	0	0	100	38	8	0	0	100	100	100	-	-
011-020	5	34	75	64	33	0	62	92	50	75	-	-	-	-	-
021-030	0	0	0	36	56	0	0	0	50	25	-	-	-	-	-
031-040	0	0	0	0	11	-	-	-	-	-	-	-	-	-	-
041-050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
051-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-010	95	71	38	0	0	90	95	50	0	0	100	85	0	0	0
011-020	5	29	50	63	13	10	5	42	83	50	0	15	92	8	0
021-030	0	0	12	25	50	0	0	8	0	42	0	0	8	92	9
031-040	0	0	0	12	25	0	0	0	17	0	0	0	0	0	73
041-050	0	0	0	0	0	-	-	-	-	-	0	0	0	0	18
051-060	0	0	0	0	12	0	0	0	0	8	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-010	100	100	25	50	33	100	100	72	-	-					
011-020	0	0	50	12	50	0	0	28	-	-					
021-030	0	0	25	38	17	-	-	-	-	-					
031-040	-	-	-	-	-	-	-	-	-	-					
041-050	-	-	-	-	-	-	-	-	-	-					
051-060	-	-	-	-	-	-	-	-	-	-					

*All plants were died after the third year.

Table 3. Breakdown of *Pinus aristata* Engelm. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	100	100	73	11	100	100	92	67	17	100	100	100	-	-
021-040	0	0	0	27	89	0	0	8	33	83	-	-	-	-	-
041-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	93	75	38	0	100	100	100	17	8	100	100	50	0	0
021-040	0	7	25	62	75	0	0	0	83	67	0	0	50	83	18
041-060	0	0	0	0	25	0	0	0	0	25	0	0	0	17	64
061-080	-	-	-	-	-	-	-	-	-	-	0	0	0	0	18
REGION 3															
Width (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	50	75	62	17	100	100	100	-	-					
021-040	0	50	25	38	83	-	-	-	-	-					
041-060	-	-	-	-	-	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					

*All plants were died after the third year.

POPULUS X CANESCENS

'TOWER'

Family:	Salicaceae
English name:	Tower Poplar
French name:	Peuplier 'Tower'
Category:	Deciduous plant
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This tree, columnar in shape, can reach a height of 12 m and a spread of nearly 2 m.

The bark is a creamy grey. The tree has numerous ascending, twisted branches.

The leaves are simple, large, and oval to rounded or even deltoid in shape. They are shiny dark green above and silvery and tomentose beneath. The dense foliage, which trembles at the slightest breeze, turns a brilliant yellow in autumn.

This cultivar does not bear fruit.

The creeping roots ensure rapid growth and little suckering occurs.

ORIGIN AND DISTRIBUTION

The species is the result of a cross between *Populus alba* and *Populus tremula*. The cultivar was developed in western Canada in the 1970s.

USE

Ornamental: The plant is used as a single specimen tree in landscaping. In mass plantings, it often serves as a screen or windbreak. The branches are very decorative in winter.

REQUIREMENTS

A sunny exposure is required for optimum growth. The tree prefers neutral or chalk soils. It is highly tolerant of pollution but very vulnerable to road salt.

Pruning is generally limited to removing dead or damaged branches.

DISEASES AND INSECTS

The cultivar is somewhat susceptible to cankers. Few problems with insects have been reported.

PROPAGATION

Cuttings: Hardwood cuttings, the thickness of a pencil, taken in late spring and containing four eyes, will root readily in soil. The use of auxins improves results; the success rate ranges from 60 % to 100 %.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (15 cm) were taken on June 19, 1991, from 12-year-old parent plants measuring roughly 8 m tall and 1 m wide. A shallow cut was made at the base of the cuttings and they were then dipped in a 5000-ppm IBA/50 % ethanol solution for 5 seconds. They were planted in plug trays filled with Promix®, Turface® and sand (2:2:1; v:v:v), and placed under a mist unit (Mist-A-Matic®). Weekly fungicide treatments with Benomyl® were given throughout the propagation period. The rooting rate was 80 % after three weeks. Misting was discontinued and the seedlings were treated with liquid fertilizer (10-52-10) at the recommended rate. They were then transferred to the lathhouse until October 15, when they were put in the cold store at 4 °C, still in their plug trays. On April 26, 1992, the seedlings were removed from

the trays, wrapped and put in the cold store to await shipping in May.

Inclusion in testing network: Seedlings 11 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Seedlings died shortly after transplanting at almost all the sites, eliminating 5-40 % of the trees.

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died the first winter. Mechanical breakage occurred in one and three plants respectively during the first and last winters.

At Sainte-Clotilde, a single seedling died during each of the first and second winters, but no other damage was observed.

At Saint-Hyacinthe, no damage occurred during the tests.

Region 2

At Sainte-Foy, one plant suffered frost damage to the one-year-old shoots the first winter and 67 % of the plants suffered mechanical damage the last winter.

At Deschambault, one seedling suffered frost damage to the branch tips during the first winter, but no other damage occurred.

At La Pocatière, one tree had mechanical damage the third winter.

Region 3

At Normandin, four seedlings died the first winter. The second winter, 70 % of trees suffered frost damage to their branch tips.

At Kapuskasing, one seedling died during each of the first two winters. The first winter, two seedlings suffered frost damage down to the ground level. Frost damage to the branch tips was observed in 12 % and 33 % of trees the second and fourth winters. One tree suffered mechanical breakage the fourth winter and another had a split trunk the last winter.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the trees after five years of testing at each site in the three regions.

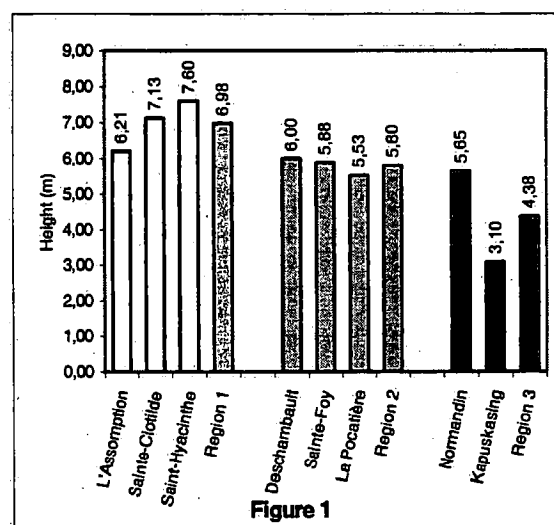


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

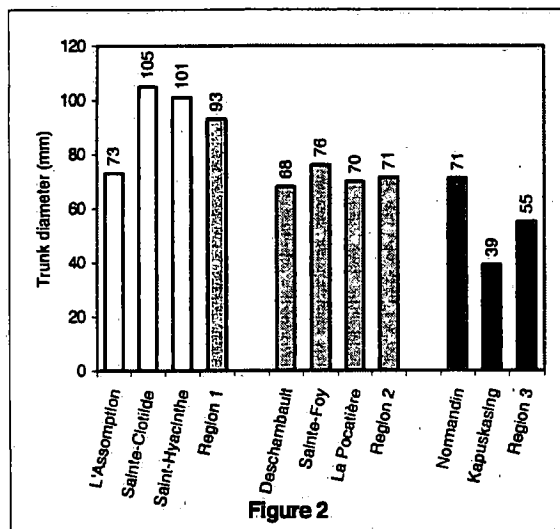


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Growth of the trees at Kapuskasing was steady but slow. At the other sites, growth was particularly good the first two years, with plants sometimes tripling their height in that time.

Effect of pruning

Only some light pruning to the branch tips was done in the trials.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and trunk diameter categories (heights and trunk diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

After three growing seasons, over 90 % of trees had surpassed a height of 3 m at the sites in regions 1 and 2, except at Saint-Hyacinthe, where the percentage was around 75 %. A fourth year was required at Normandin for trees to reach this size, whereas only half of the plants at Kapuskasing had reached this size by the end of the trial.

In terms of trunk diameter, over 75 % of the trees at Sainte-Clotilde and Sainte-Foy had a trunk diameter of over 41 cm after three growing seasons. It took an additional year to attain a similar diameter at the four other sites in zones 1 and 2. A fifth growing season was required at Normandin, while only 42 % of trees at Kapuskasing had attained this diameter by the end of the trial.

The cultivar can be easily produced at all sites in regions 1 and 2.

HARDINESS EVALUATION

According to the literature, the species is hardy to zone 3. The test results show that the cultivar will survive as a young plant as far as zone 2a. Since damage was light at all sites, the cultivar can be used as far as zone 2a, although growth will be slow.

Full ornamental potential was achieved in the young trees at the sites in regions 1 and 2, notwithstanding the mechanical damage that can occur at this age.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 18, 28, 31, 33, 35

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Populus x canescens* 'Tower' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		1	2	4	5	6	7	8	9	10	
REGION 1											
L'Assomption	93							1		6	7
Sainte-Clotilde	97							3			3
Saint-Hyacinthe	100										0
REGION 2											
Deschambault	99	1									1
Sainte-Foy	85			2						13	15
La Pocatière	98									2	2
REGION 3											
Normandin	80	14						6			20
Kapuskasing	83	9					2	2	2	2	17

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 5, 6 and 11 occurred for this cultivar.

Table 2. Breakdown of *Populus x canadensis* 'Tower' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-150	100	18	0	0	0	100	17	0	0	0	100	0	17	0	0
151-300	0	82	8	9	0	0	66	11	11	0	0	33	8	0	0
301-450	0	0	83	8	17	0	17	56	11	11	0	67	8	0	0
451-600	0	0	9	83	16	0	0	33	11	11	0	0	67	25	0
601-750	0	0	0	0	67	0	0	0	67	22	0	0	0	75	8
751-900	-	-	-	-	-	0	0	0	0	56	0	0	0	0	92
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-150	100	0	0	0	0	100	7	0	0	0	100	6	0	0	0
151-300	0	100	8	0	0	0	93	8	0	0	0	94	8	8	8
301-450	0	0	92	33	0	0	0	92	17	0	0	0	92	50	0
451-600	0	0	0	67	50	0	0	0	83	67	0	0	0	42	58
601-750	0	0	0	0	50	0	0	0	0	33	0	0	0	0	34
751-900	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapusksing									
	92	93	94	95	96	92	93	94	95	96					
001-150	100	22	0	0	0	100	88	59	8	0					
151-300	0	78	33	0	0	0	12	33	50	50					
301-450	0	0	67	56	0	0	0	8	42	42					
451-600	0	0	0	44	89	0	0	0	0	8					
601-750	0	0	0	0	11	-	-	-	-	-					
751-900	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Populus x canadensis* 'Tower' plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	67	8	8	100	50	22	11	11	100	100	42	0	0
041-080	0	0	33	83	59	0	50	78	11	11	0	0	58	42	0
081-120	0	0	0	9	33	0	0	0	78	56	0	0	0	58	92
121-160	-	-	-	-	-	0	0	0	0	22	0	0	0	0	8

Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	100	8	0	100	100	25	0	0	100	100	67	8	8
041-080	0	0	0	92	100	0	0	75	100	75	0	0	33	92	58
081-120	0	0	0	0	0	0	0	0	0	25	0	0	0	0	34
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Trunk diameter (mm)	REGION 3									
	Normandin					Kapusking				
	92	93	94	95	96	92	93	94	95	96
001-040	100	100	89	33	0	100	100	100	92	58
041-080	0	0	11	67	78	0	0	0	8	42
081-120	0	0	0	0	22	-	-	-	-	-
121-160	-	-	-	-	-	-	-	-	-	-

POTENTILLA FRUTICOSA

'GOLDSTAR'

Family:	Rosaceae
English name:	Gold Star Cinquefoil
French name:	Potentille frutescente 'Goldstar'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small, compact shrub, of semi-erect, irregular habit, can grow to over 0.9 m tall and 1.2 m wide.

The foliage is dark green or slightly silvery. The sessile trifoliate leaves have involute margins and are linear to oblong or elliptic in shape. They are only 1-3 cm long, which is small for a cinquefoil.

The large bright golden-yellow flowers are slightly smaller than those of the cultivar 'Goldfinger'. They appear in June and flowering continues until the first frosts of fall.

ORIGIN AND DISTRIBUTION

This cultivar was selected in Germany in 1976 by Johan Hachman de Barmstedt.

USE

Ornamental: This cultivar is used as a specimen plant or in mass plantings.

REQUIREMENTS

Cinquefoils do best in full sun, but will tolerate partial shade, although growth and flowering will not be as good. They survive transplanting very well. These plants must be pruned regularly and overgrown specimens renewed.

DISEASES AND INSECTS

Fairly resistant to diseases and insects, cinquefoils may suffer from mildew and various leaf spots. They occasionally fall prey to mites.

PROPAGATION

Cuttings: This cultivar is usually propagated with semi-woody cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Dominique Savio, Saint-Jean-Baptiste-de-Rouville (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 405 cuttings, 10-12 mm long, were taken on July 24, 1990, from two-year-old parent plants measuring 30 cm high and 30 cm wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution, planted in plug trays filled with sand and perlite (2:1; v:v) and placed under a mist unit (Mist-A-Matic®). Weekly fungicide treatments with Benomyl® were given throughout the propagation period. The rooting rate was 95 % after eight weeks. The seedlings were grown in a bed during the entire growing season and were treated with soluble fertilizer. They overwintered under a heavy snow cover; the survival rate was 100 %. On April 23, 1991, the seedlings were wrapped, put in plastic bags and placed in the cold store at 5 °C to await shipping in May.

Inclusion in testing network: Young seedlings 3-6 cm high and 2-3 cm wide were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

A few seedlings died shortly after transplanting at L'Assomption.

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 100 %, 100 % and 33 % of plants suffered frost damage to the branch tips the first three winters.

At Sainte-Clotilde, 20 % of seedlings died the first winter. In addition, 67 % of the shrubs had frost damage to branch tips the fourth winter.

At Saint-Hyacinthe, one seedling died the second winter. Frost damage to branch tips occurred in 33 %, 100 % and 33 % of shrubs the second, third and fourth winters, but no other damage occurred.

Region 2

At Deschambault, the only damage observed was from rodents, found in 33 % of the shrubs during the last winter.

At Sainte-Foy, no damage occurred during the tests.

At La Pocatière, mechanical breakage occurred in 33 % of shrubs the fourth winter.

Region 3

At Normandin, a single plant suffered mechanical breakage during the third winter.

At Kapuskasing, one seedling died the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

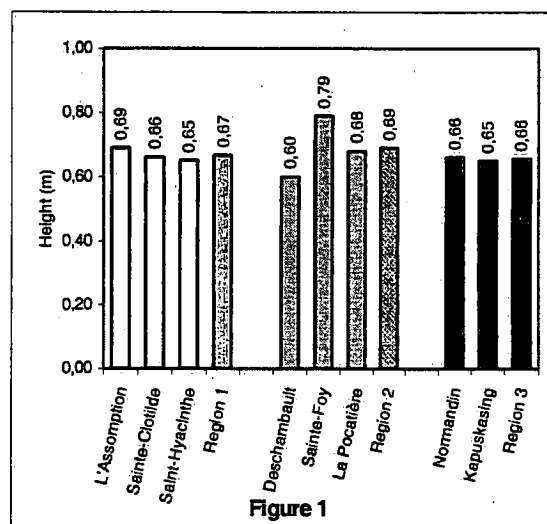


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

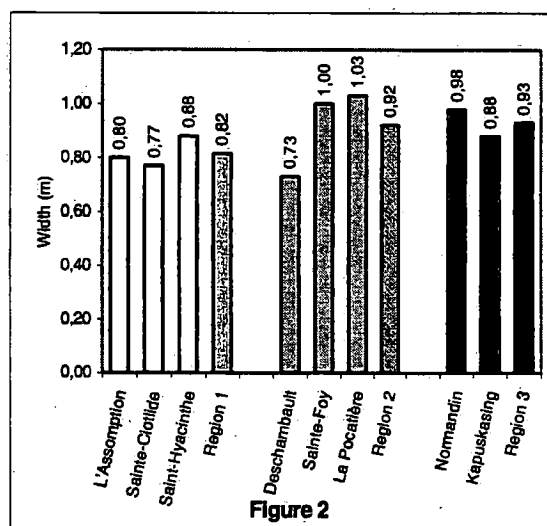


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

At Sainte-Clotilde, Sainte-Foy, Deschambault and Kapuskasing, height and width increased every year, while at Saint-Hyacinthe, no height growth occurred after the end of the third year. At the other sites, height growth peaked at the end of the fourth year.

Effect of pruning

Little pruning was done, except at Saint-Hyacinthe.

Flowering

Flowering lasted for 130 days at the sites in region 1, around 105-130 days at the sites in region 2 and 110 days at the sites in region 3. Duration depends on the timing of spring and the intensity of pruning. At all sites, flowering ended with the first fall frosts.

In region 1, the first flowers appeared between June 8 and June 15, and in region 2, June 10-24. At Normandin and Kapuskasing, the appearance of the first flowers was more variable, between June 18 and July 6 depending on the year and extent of pruning.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

This cultivar grows very quickly and, after three growing seasons, all the shrubs at Saint-Hyacinthe, Normandin and La Pocatière had reached a height of 40-60 cm, while 85-95 % of shrubs at L'Assomption, Sainte-Clotilde and Sainte-Foy had reached a comparable height by the same time. However, at Deschambault and Kapuskasing, only 58 % and 20 % of shrubs respectively reached a comparable height by this time.

Width growth was greater and more rapid than height growth in this shrub of semi-erect habit.

HARDINESS EVALUATION

According to the literature, *Potentilla fruticosa* is hardy to zone 2 in both the USDA and Canadian systems. The test results show that it is hardy as far as zone 2a, with mortality in that zone qualified as accidental.

Since winter damage was very light in zone 2a, it is conceivable that the variety will survive in zone 1b.

The cultivar can be used as far as zone 2. It achieved its full ornamental potential at sites in zones 2 and 4, with plants suffering damage to the branch tips in zone 5.

BIBLIOGRAPHIC REFERENCES

2, 7, 9, 21, 31, 33, 35

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Potentilla fruticosa* 'Goldstar' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	53	46						1			47
Sainte-Clotilde	83	13						4			17
Saint-Hyacinthe*	66	33						1			34
REGION 2											
Deschambault	92	2								6	8
Sainte-Foy	100										0
La Pocatière	93								7		7
REGION 3											
Normandin	98								2		2
Kapuskasing	99							1			1

^a Key:

- 1 = no damage
 2 = damage to the tip of the previous year's shoot
 3 = frost damage on the flower buds
 4 = previous year's shoot affected
 5 = old wood affected
 6 = dead down to the level of snow cover

- 7 = dead down to the ground surface
 8 = dead
 9 = sunscald, trunk spitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

*Damage was evaluated over a three-year period.

No damage of type 3, 4, 5, 6, 7 and 9 occurred for this cultivar.

Table 2. Breakdown of *Potentilla fruticosa* 'Goldstar' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	13	0	0	0	81	23	0	0	0	-	0	0	0	0
021-040	0	87	8	0	0	19	72	17	0	0	-	0	0	0	0
041-060	0	0	84	0	17	0	5	83	92	33	-	95	33	58	17
061-080	0	0	8	100	75	0	0	0	8	67	-	5	67	42	83
081-100	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	91	0	0	0	0	63	0	0	0	0	28	5	0	0	0
021-040	9	76	42	0	0	37	67	16	0	0	72	85	0	0	0
041-060	0	24	58	75	58	0	33	68	33	0	0	10	67	0	8
061-080	0	0	0	25	42	0	0	16	67	58	0	0	33	83	92
081-100	-	-	-	-	-	0	0	0	0	42	0	0	0	17	0
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	76	10	0	0	0	100	78	0	0	0					
021-040	24	85	0	0	0	0	22	84	0	0					
041-060	0	5	92	17	33	0	0	16	92	25					
061-080	0	0	8	83	67	0	0	0	8	67					
081-100	-	-	-	-	-	0	0	0	0	8					

*Data were collected since 1992.

Table 3. Breakdown of *Potentilla fruticosa* 'Goldstar' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	87	0	0	0	100	82	0	0	0	-	5	0	0	0
041-080	0	13	100	100	42	0	18	100	100	75	-	95	50	8	33
081-120	0	0	0	0	58	0	0	0	0	25	-	0	50	92	67
121-140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	81	5	0	0	0	33	0	0	0	0	91	24	0	0	0
041-080	19	90	92	92	83	67	100	100	42	8	9	76	50	0	0
081-120	0	5	8	8	17	0	0	0	58	92	0	0	50	100	100
121-140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	62	0	0	0	0	75	28	0	0	-					
041-080	38	58	42	8	0	25	72	91	75	-					
081-120	0	42	50	92	100	0	0	9	25	-					
121-140	0	0	8	0	0	-	-	-	-	-					

*Data were collected since 1992.

POTENTILLA FRUTICOSA

'MCKAY'S WHITE'

Family:	Rosaceae
English name:	McKay's White Cinquefoil
French name:	Potentille frutescente 'McKay's White'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small, compact shrub, of semi-erect, irregular habit, may grow to over 1.25 m tall and 1.6 m wide, making it slightly wider than it is tall.

The foliage is medium green. The sessile trifoliate leaves have involute margins and are linear to oblong or elliptic in shape. They are 1-3 cm long.

The white flowers occasionally have double petals (7-10 petals). As in all cinquefoils, flowering begins in June.

ORIGIN AND DISTRIBUTION

The cultivar was selected in 1985 by B. Fourier of McKay Nursery in Wisconsin (U.S.).

USE

Ornamental: This cultivar is used as a specimen plant or in mass plantings.

REQUIREMENTS

Cinquefoils do best in full sun, but will tolerate partial shade, although growth and flowering will not be as good. They survive transplanting very well. These plants must be pruned regularly and overgrown specimens renewed.

DISEASES AND INSECTS

Fairly resistant to diseases and insects, cinquefoils may suffer from mildew and various leaf spots. They occasionally fall prey to mites.

PROPAGATION

Cuttings: This cultivar is usually propagated with semi-woody cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Dominique Savio, Saint-Jean-Baptiste-de-Rouville (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 450 cuttings, 10-12 mm long, were taken on July 24, 1990, from two-year-old parent plants measuring 30 cm high and 30 cm wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution, planted in flats of sand and perlite (2:1; v:v) in a greenhouse and placed under a mist unit (Mist-A-Matic®). Weekly fungicide treatments with Benomyl® were given throughout the propagation period. The rooting rate was 98 % after eight weeks. The seedlings were cultivated in a bed during the entire growing season and were treated with 10-52-10 soluble fertilizer. They overwintered under a heavy snow cover; the survival rate was 100 %. On April 23, 1991, the seedlings were wrapped, put in plastic bags and placed in the cold store at 5 °C to await shipping in May.

Inclusion in testing network: Young seedlings 4-7 cm high and 2-5 cm wide were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Shortly after transplanting, 10-12 % of seedlings at Kapuskasing and La Pocatière died and close to 25 % at Sainte-Clotilde and Sainte-Foy died.

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, all seedlings had frost damage to the branch tips during the first two winters. No damage occurred the last three winters.

At Sainte-Clotilde, 13 % of seedlings died during the first winter and 27 % of shrubs had frost damage to branch tips in the fourth winter. No other damage was observed during the trial.

At Saint-Hyacinthe, one plant died the first winter and another had frost damage to the aerial portion down to the ground level in the fourth winter. During the last three winters, 67 %, 25 % and 33 % of plants had frost damage to the branch tips.

Region 2

At Deschambault, a single seedling had frost damage to the branch tips the first winter. No other seedlings were affected during the trial.

At Sainte-Foy, a single seedling died the first winter but no other damage was observed during the trial.

At La Pocatière, no damage occurred during the tests.

Region 3

At Normandin, one shrub suffered mechanical breakage after the third winter.

At Kapuskasing, a number of shrubs died during the first three winters (63 %, 33 % and 33 % of shrubs). Frost damage to the aerial portion above the snow cover occurred in one plant the second winter. Frost damage to the previous year's shoots occurred in 6 % and 50 % of plants during the first two winters. In addition, 31 % of seedlings suffered frost damage to the branch tips during the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

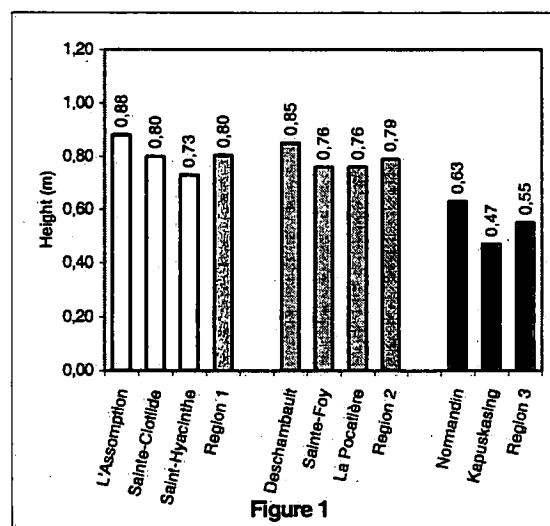


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

The width of the seedlings increased annually at all sites, except Deschambault, where width growth ceased after the third growing season.

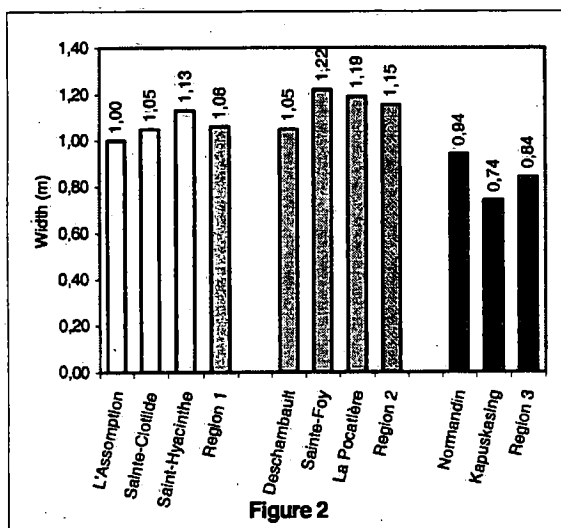


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

Little pruning was done, except at Saint-Hyacinthe.

Flowering

Flowering lasted for roughly 120 days at the sites in region 1 and around 105-122 days at the sites in region 2. In region 3, the duration was around 112 days at Normandin; at Kapuskasing, flowering was less frequent, sparser and more irregular from year to year. The duration of flowering depends on the timing of spring and the intensity of pruning. At all sites, flowering ended with the first autumn frosts.

In region 1, the first flowers appeared between May 30 and June 5, which is a week earlier than for 'Goldstar'. In regions 2 and 3, flowering began between June 8 and 22.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Height growth in this species is slower than in 'Goldstar', evaluated at the same time. After two growing seasons, all the shrubs at Saint-Hyacinthe had reached a height of 40-60 cm; roughly 85 % of seedlings at Sainte-Clotilde, Sainte-Foy and Deschambault had reached a comparable height by then. At the other sites, an additional year was required to attain the same size, except at Kapuskasing, where a fourth year was required.

Width growth was greater and more rapid than height growth in this shrub of semi-erect habit.

HARDINESS EVALUATION

According to the literature, *Potentilla fruticosa* is hardy to zone 2 (USDA and Canadian systems). The significant mortality during the first three winters at Kapuskasing suggests that survival is not a sure thing in zone 2a. However, the shrub had excellent results in zone 2b.

The cultivar can be used as far as zone 2b. It achieved its full ornamental potential in zones 4 and 5, where the plentiful snow cover helps prevent winter damage.

BIBLIOGRAPHIC REFERENCES

2, 7, 9, 21, 31, 33, 35, 39

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Potentilla fruticosa* 'McKay's White' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	60	40										40
Sainte-Clotilde	92	6						2				8
Saint-Hyacinthe	72	25					2	1				28
REGION 2												
Déschambault	98	2										2
Sainte-Foy	99							1				1
La Pocatière	100											0
REGION 3												
Normandin	98									2		2
Kapuskasing	46	6		11			3	24		10		54

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6 and 11 occurred for this cultivar.

Table 2. Breakdown of *Potentilla fruticosa* 'McKay's White' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	45	0	0	0	0	13	0	0	0	0	-	0	0	0	0
021-040	55	65	0	0	0	87	22	0	0	0	-	0	0	0	0
041-060	0	35	83	0	0	0	78	55	18	0	-	70	25	25	8
061-080	0	0	17	42	17	0	0	45	82	45	-	30	67	75	75
081-100	0	0	0	58	83	0	0	0	0	55	-	0	8	0	17
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	15	0	0	0	0	42	0	0	0	0	5	0	0	0	0
021-040	85	15	0	0	0	58	18	0	0	0	95	37	0	0	0
041-060	0	85	17	0	0	0	82	58	8	0	0	73	66	0	0
061-080	0	0	83	92	92	0	0	42	84	83	0	0	34	100	100
081-100	0	0	0	8	8	0	0	0	8	17	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	0	0	0	0	0	75	33	0	0	0					
021-040	95	100	25	0	0	25	67	100	50	50					
041-060	5	0	75	42	33	0	0	0	50	0					
061-080	0	0	0	58	67	0	0	0	0	50					
081-100	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Table 3. Breakdown of *Potentilla fruticosa* 'McKay's White' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	0	0	0	0	100	14	0	0	10	-	0	0	0	0
041-080	0	100	8	8	0	0	86	45	9	18	-	100	8	0	0
081-120	0	0	92	92	100	0	0	55	91	36	-	0	92	100	83
121-140	-	-	-	-	-	0	0	0	0	36	-	0	0	0	17
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	57	0	0	0	0	25	0	0	0	0	85	0	0	0	0
041-080	43	57	0	0	0	75	56	42	0	0	15	100	25	0	0
081-120	0	43	100	100	100	0	44	28	100	50	0	0	75	92	50
121-140	-	-	-	-	-	0	0	0	0	50	0	0	0	8	50
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	20	0	0	0	0	69	67	33	0	0					
041-080	80	35	42	8	17	31	33	67	100	50					
081-120	0	65	58	92	83	0	0	0	0	50					
121-140	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

PRUNUS BESSEYI L.H. BAILEY.

Family:	Rosaceae
English name:	Sand Cherry
French name:	Cerisier des sables
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub of rounded, irregular and diffuse habit can reach 1.5 m tall and 2.5 m wide.

The twigs give off a strong almondy scent when bruised.

The buds consist of 10-15 scales in several rows. Each leaf scar has three vein scars.

The shiny, glaucous-green foliage turns rusty purple in autumn. The oval, dentate leaves are 2-5 cm long. They are conduplicate in the bud.

The small white flowers occur in clusters of 2 or 4. Each flower has five sepals, five petals and a single pistil. They are sparse and appear in early spring after leaf-out.

The small red, edible fruits appear in July, blackening as they ripen.

The shallow roots sucker easily.

ORIGIN AND DISTRIBUTION

The species' natural range, known since 1892, extends from Manitoba to Wyoming through Kansas and southern Colorado.

USE

Ornamental: The graceful flowers and delicate fruits are of great interest both in small gardens and larger landscaped areas, where this shrub can be used either as a specimen plant or in mass plantings.

Naturalization: This species lends itself well to naturalization and the fruits attract birds.

DISEASES AND INSECTS

The tree is very susceptible to fireblight when grown in dry soils and may be attacked by caterpillars in spring.

REQUIREMENTS

The shrub thrives in a sunny site, preferably sheltered from the wind. Undemanding, it tolerates sandy, dry soils as well as road salt. A light pruning to get rid of dead wood and other winter damage can be done in spring after flowering.

PROPAGATION

Seeds: The fruits are harvested and the seeds extracted in August. Sowing can be done immediately afterward, allowing natural stratification of the seeds over the winter. The seeds, sown in the spring, must have been stratified first.

Cuttings: Semiripe cuttings, taken in early summer, will usually root after three or four weeks.

Grafting: The species is a good rootstock for several *Prunus* cultivars difficult to propagate by cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: 320 cuttings were taken on June 21, 1990, from three-year-old parent plants. They were dipped for five seconds in a 4,000 ppm-IBA/50 % ethanol solution and planted in plug trays filled with Promix® and perlite (1:2; v:v), and then put under a mist unit operating for 30 seconds every seven minutes. The rooting rate was 55 % after four weeks. The seedlings overwintered in glass

cold frames. The winter survival rate was 100 %. On May 3, 1991, they were wrapped in plastic bags and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Young seedlings 15 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

A total of 5 % of seedlings died just after transplanting at L'Assomption, Sainte-Clotilde and Sainte-Foy. Seedling mortality was more significant at La Pocatière (24 %), Normandin (50 %) and Kapuskasing (40 %).

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites

In general, damage was relatively infrequent in regions 1 and 2.

Region 1

At L'Assomption, no damage occurred the first, third and last winters. The second winter, 62 % of seedlings had frost damage to the branch tips and one plant suffered mechanical breakage. The fourth winter, one third of plants were damaged by the weight of the snow.

At Sainte-Clotilde, only two plants suffered frost damage to the branch tips.

At Saint-Hyacinthe, 10 % of shrubs died the second and third winters. In addition, 24 % of shrubs suffered frost damage to the aerial portions above the snow cover.

Region 2

At Sainte-Foy, over half the seedlings had frost damage to the branch tips the second winter. The following winter,

25 % of shrubs had similar damage and a third suffered rodent damage.

One seedling died the first winter at Deschambault. The second winter, a single plant suffered frost damage to the branch tips. Mechanical breakage occurred in close to half of the shrubs the third winter and in 16 % the last winter. The last winter, 25 % of shrubs were damaged by rodents.

At La Pocatière, 42 % of plants had frost damage to the branch tips the third winter. One third of the shrubs suffered mechanical breakage the following winter.

Region 3

At Normandin, 10 % of plants died during the third winter, and an equal percentage succumbed the fourth winter. Frost damage to the branch tips was observed in 100 %, 90 % and 11 % of shrubs the second, third and fifth winters. Close to one third suffered mechanical breakage the first winter.

At Kapuskasing, 13 %, 69 %, 33 % and 50 % of shrubs died the first four winters. No damage occurred the last winter in the single surviving plant. The branch tips were affected in 40 % and 8 % of seedlings the first and second winters. Frost damage to the one-year-old shoots occurred in 67 % and 50 % of seedlings the third and fourth winters. One seedling had damage to the entire aerial portion above the ground level during the first winter. Mechanical breakage was observed in 15 % of seedlings the second winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

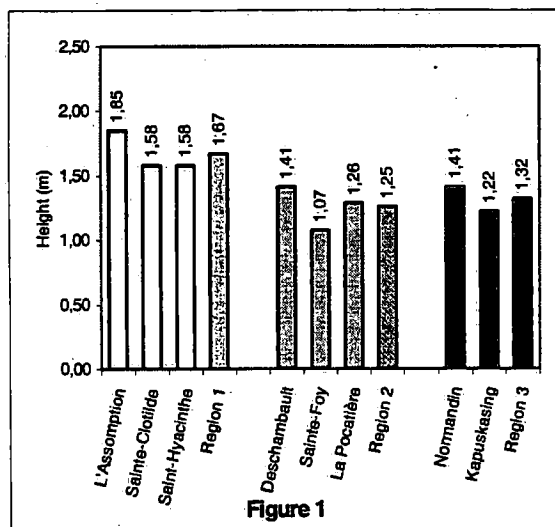


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

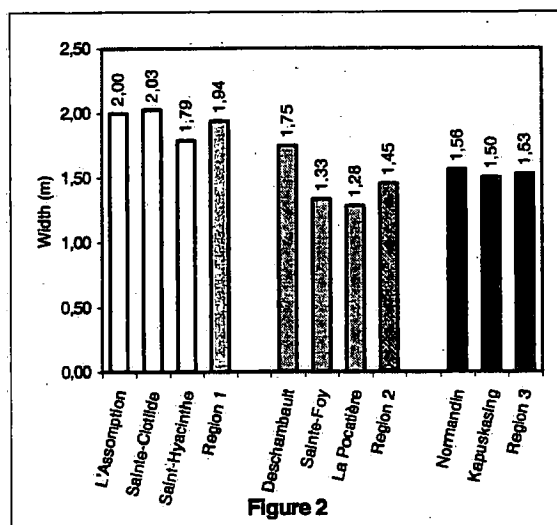


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

At Sainte-Foy and La Pocatière, height growth was recorded until the fourth year. The height of the shrubs at Normandin did not change after the end of the third growing season, while it increased every year at the other sites.

Seedlings were wider than tall by the third year.

Effect of pruning

At L'Assomption and Sainte-Foy, extensive pruning was required to counter damage from the weight of the snow, and the top half of the stems had to be cut back. At La Pocatière, such extensive pruning was only required the last winter. At Saint-Hyacinthe, Deschambault and Normandin, only light annual pruning was required. No pruning was done at Sainte-Clotilde.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After three growing seasons, all the shrubs at Sainte-Clotilde and Normandin were over 1 m tall, compared to only 92 % at Saint-Hyacinthe, Deschambault and La Pocatière. A fourth growing season was required to obtain plants of comparable height at L'Assomption and Kapuskasing.

This species can be field-grown at all trial sites except Kapuskasing, where mortality was excessive.

HARDINESS EVALUATION

According to the literature, the species is hardy to anywhere from zone 5a to zone 2b, depending on the author and reference. The test results show that the species can survive and be used as far as zone 2b, since only one plant survived in zone 2a.

In addition, in areas with significant snow cover, mechanical breakage of the branches is often a problem. Rodent damage was also found occasionally.

The species achieved its full ornamental potential at Sainte-Clotilde, in hardiness zone 5b.

BIBLIOGRAPHIC REFERENCES

2, 7, 8, 9, 13, 19, 26, 30, 31, 33, 34, 75, 76

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Prunus besseyi* L.H. Bailey. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		1	2	3	4	5	6	7	8	9	10	
REGION 1												
L'Assomption	80	40								8		20
Sainte-Clotilde	98	6										2
Saint-Hyacinthe*	92	25				5		3				8
REGION 2												
Deschambault	81	2						1		12	5	19
Sainte-Foy	78										6	22
La Pocatière	85									7		15
REGION 3												
Normandin	50							4		6		50
Kapuskasing	30	6		23			1	33		4		70

- * Key:
- | | | | |
|-----|------------------------------------------------|------|---------------------------------------------------|
| 1 = | no damage | 7 = | dead down to the ground surface |
| 2 = | damage to the tip of the previous year's shoot | 8 = | dead |
| 3 = | frost damage on the flower buds | 9 = | sunscald, trunk spitting |
| 4 = | previous year's shoot affected | 10 = | mechanical breakage related to weather conditions |
| 5 = | old wood affected | 11 = | damage by rodents |
| 6 = | dead down to the level of snow cover | | |

*Damage was evaluated over a four-year period.

No damage of type 3, 5 and 9 occurred for this species.

Table 2. Breakdown of *Prunus besseyi* L.H. Bailey, plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	48	0	0	0	0	90	0	0	0	0	-	0	0	0	0
051-100	52	86	25	0	0	10	80	0	17	17	-	23	8	0	0
101-150	0	14	75	17	25	0	20	75	25	25	-	67	25	46	45
151-200	0	0	0	83	42	0	0	25	42	41	-	10	67	54	46
201-250	0	0	0	0	33	0	0	0	16	17	-	0	0	0	9
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	90	0	0	0	0	100	5	0	0	0	29	0	0	0	0
051-100	10	53	8	0	0	0	95	67	25	58	71	41	8	0	33
101-150	0	47	84	92	83	0	0	33	67	25	0	59	92	25	33
151-200	0	0	8	8	17	0	0	0	8	17	0	0	0	75	34
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	0	0	0	0	0	73	46	0	0	0					
051-100	100	0	0	0	11	27	54	100	0	0					
101-150	0	100	0	50	88	0	0	0	100	100					
151-200	0	0	100	40	11	-	-	-	-	-					
201-250	0	0	0	10	0	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Prunus besseyi* L.H. Bailey plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	81	0	0	0	100	0	0	0	0	-	0	0	0	0
051-100	0	19	8	0	0	0	35	0	0	0	-	5	0	0	9
101-150	0	0	17	8	8	0	60	0	16	0	-	86	58	36	18
151-200	0	0	75	50	58	0	5	75	8	42	-	9	42	46	37
201-250	0	0	0	42	17	0	0	25	67	58	-	0	0	18	36
251-300	0	0	0	0	17	0	0	0	9	0	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	65	0	0	0	0	90	0	0	0	0	82	0	0	0	0
051-100	35	5	0	0	0	10	15	25	0	17	18	53	0	0	33
101-150	0	37	17	25	17	0	80	75	33	58	0	47	67	0	42
151-200	0	53	58	75	66	0	5	0	67	25	0	0	33	100	25
201-250	0	5	25	0	17	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	36	0	0	0	0	100	69	0	0	0					
051-100	64	0	0	0	0	0	31	100	0	0					
101-150	0	0	0	10	44	0	0	0	100	100					
151-200	0	100	100	80	56	-	-	-	-	-					
201-250	0	0	0	10	0	-	-	-	-	-					
251-300	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

RHODODENDRON CANADENSE

(L.) TORR.

Family:	Ericaceae
English name:	Canadense Rhodora
French name:	Rhododendron du Canada
Category:	Deciduous shrub
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This native shrub of erect habit measures 0.5-1.0 m high and wide. It is sparsely branched and the stiff, brittle twigs give it a fragile look.

The alternate deciduous leaves are 2-6 cm long and short-petioled. They are oblong to oval in shape, with an obtuse apex and slightly rolled margins. The upper surface is dark green and the underside, pale and slightly pubescent.

Flowering occurs in early May, before the leaves unfurl. The shrub is covered in tight clusters of bilaterally symmetrical purplish-pink flowers. The flowers are small, rarely exceeding 2 cm in diameter.

The fruit is a sturdy capsule, which is usually glandular and pubescent. It ranges in length from 1 to 2 cm.

ORIGIN AND DISTRIBUTION

Native to Canada, this species grows in bogs and other areas with acid soil in the sugar maple-hickory and sugar maple-yellow birch ecoregions, in the forests of the Laurentian Mountains and the north shore of the St. Lawrence. The plant was described by Linnaeus in 1762 as *Rhodora canadense* and subsequently moved to the genus *Rhododendron*.

USE

Ornamental: The species is used as a specimen plant and in mass plantings on moist acid soils. When cultivated in a

garden, it has a much denser habit than when it grows under natural conditions.

REQUIREMENTS

Although the species can tolerate a semi-shady location, it grows and flowers best in full sun. In a garden, it requires a light, moist, slightly sandy soil with an acid pH (5.5). Annual applications of an organic mulch such as pine needles or oak leaves will reduce soil moisture and temperature fluctuations, thus imitating the natural conditions under which the species thrives. During a prolonged drought, the shrub must be watered regularly.

DISEASES AND INSECTS

Rhododendrons may be affected by fungal diseases such as grey mould (*Botrytis*), root and collar rots (*Phytophthora*, *Sclerotinia* or *Pythium*) and powdery mildew.

Good cultural practices will reduce damage from weevils.

PROPAGATION

Seeds: This species can be propagated from seeds. The capsules are harvested before they open and the seeds are sown immediately in a mixture of sphagnum and sand, covered with a fine layer of peat moss. The substrate must remain moist throughout the germination period.

Pollination: In the plant's natural environment, the flowers of *R. canadense* are pollinated by female bumblebees, the only ones active during anthesis.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 591 cuttings (8 cm) were taken on June 26, 1989, from parent plants around 15 years old. The cuttings were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution, and then rinsed under tap

water. They were then immersed in a fungicide bath (Benomyl-Captan®), planted in a peat-perlite mixture (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 68 % after 48 days. The seedlings were potted up on August 16 in Fertil Pot® filled with peat and perlite (3:2; v:v). Weekly treatments with a soluble fertilizer (20-20-20, 200 ppm N) continued until mid-September. The seedlings were kept in an unheated greenhouse until November, when they were put in the cold store at 0 °C in plastic bags perforated with a hatpin. In May 1990, 280 seedlings were transplanted to the nursery, where they were grown on for two years. In May 1992, they were dug up, puddled, wrapped and put in the cold store at 4 °C, to be shipped a few days later.

Inclusion in testing network: Seedlings 15-25 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

In general, winter damage was slight at most of the sites.

Region 1

At L'Assomption, a single shrub suffered mechanical breakage during the fourth winter.

At Sainte-Clotilde, 87 % of shrubs died the third winter and the remaining two died the following winter. No frost damage occurred before this mortality.

At Saint-Hyacinthe, 15 % and 11 % of the shrubs died the second and third winters respectively. During the third winter, frost damage to the branch tips occurred in 22 % of

shrubs and damage to the entire aerial portion of the plant occurred in 5 % of shrubs.

Region 2

At Sainte-Foy, 17 % of shrubs died the third winter. In addition, frost damage to the floral buds was observed in 10 % of the plants the last winter.

At Deschambault, mechanical breakage occurred in 8 %, 33 % and 25 % of shrubs the last three winters.

At La Pocatière, two seedlings died the second winter, while one seedling had frost damage to the branch tips and another had damage to the one-year-old shoots.

Region 3

At Normandin, one plant died in each of the second and third winters. One shrub had frost damage to the branch tips the first winter and mechanical breakage was observed in 64 % of plants the last winter.

At Kapuskasing, 11 %, 6 %, 27 % and 63 % of seedlings died the first four winters, leaving only three plants. Frost damage to the one-year-old shoots occurred in 17 %, 13 %, 36 % and 38 % of shrubs the first four winters. In addition, 27 % of shrubs suffered frost damage to the branch tips during the third winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

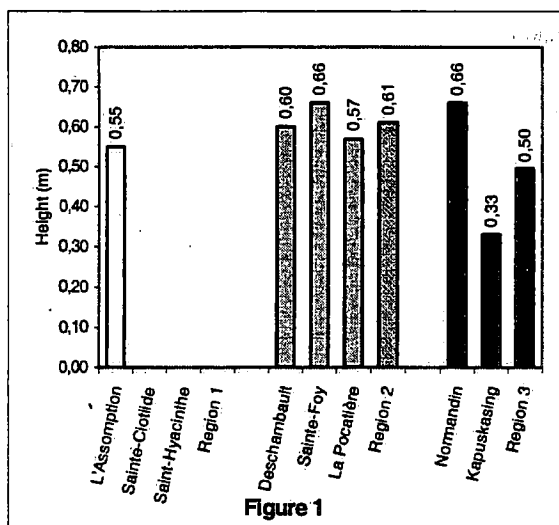


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

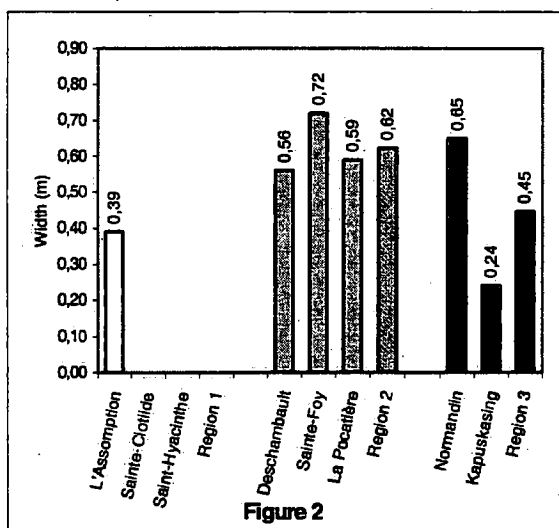


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Height growth occurred every year at L'Assomption, Deschambault, Sainte-Foy, La Pocatière and Normandin. Growth was particularly homogenous in region 2.

Effect of pruning

No pruning was done.

Flowering

At L'Assomption, flowering began between May 13 and 21 and continued for 7-15 days. At all region 2 sites, flowering began between May 25 and 30, depending on the year. In Kapuskasing, the first flowers appeared between June 1 and 12, and flowering continued for 10-24 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Successful production of this species is linked to snow cover, especially in the Montreal region, where the snow cover may disappear during cold periods, leaving shrubs vulnerable to winter damage. After three growing seasons, 80 % of shrubs at L'Assomption (region 1), 100 % of shrubs in region 2, and 90 % at Normandin (region 3) had reached a height of 41-60 cm.

It is recommended that this species be produced in areas where there is a heavy accumulation of snow early in the season.

HARDINESS EVALUATION

The species was slightly hardier than suggested by Landry *et al.* (1980), who rated it as hardy to zone 3. At Normandin (zone 2b), little frost damage occurred.

The species can be used as far as zone 2b. However, its use is limited in heavy, poorly drained soils and not recommended in calcareous soils. In addition, the plant's very short flowering period also limits its use, despite the fact that it is one of our most beautiful native plants.

The species achieved its full ornamental potential in zones 4b and 5a.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 28, 36, 39, 62, 64

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Rhododendron canadense* (L.) Torr. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	98								2		2
Sainte-Clotilde	71							29			29
Saint-Hyacinthe	89	4					1	6			11
REGION 2											
Deschambault	87								13		13
Sainte-Foy	95		2					3			5
La Pocatière	96	1		1				2			4
REGION 3											
Normandin	83	1						3	13		17
Kapuskasing	41	7		26				26			59

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 5, 6, 9 and 11 occurred for this species.

Table 2. Breakdown of *Rhododendron canadense* (L.) Torr. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	0	0	0	0	0	100	100	100	-	-	0	6	0	-	-
021-040	90	86	17	8	0	-	-	-	-	-	57	56	94	-	-
041-060	10	14	83	92	83	-	-	-	-	-	43	38	6	-	-
061-080	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
021-040	86	62	0	0	0	70	15	0	0	0	79	84	0	0	0
041-060	14	38	100	83	50	30	85	83	40	30	21	16	100	91	73
061-080	0	0	0	17	50	0	0	17	50	70	0	0	0	9	27
081-100	-	-	-	-	-	0	0	0	10	0	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	100	0	0	0	6	0	0	0	0					
021-040	0	0	8	0	0	88	94	83	100	100					
041-060	0	0	41	82	36	6	6	17	0	0					
061-080	0	0	51	18	64	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

*Data were collected until 1994.

Table 3. Breakdown of *Rhododendron canadense* (L.) Torr. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	43	17	0	0	100	100	100	-	-	95	100	94	-	-
021-040	0	57	83	75	67	-	-	-	-	-	5	0	6	-	-
041-060	0	0	0	25	33	-	-	-	-	-	-	-	-	-	-
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	67	0	0	0	0	20	10	0	0	0	42	16	0	0	0
021-040	33	100	75	58	8	80	90	25	0	0	58	84	27	9	9
041-060	0	0	25	42	75	0	0	67	30	30	0	0	73	82	36
061-080	0	0	0	0	17	0	0	8	70	30	0	0	0	9	55
081-100	-	-	-	-	-	0	0	0	0	40	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	56	0	0	0	11	63	67	75	67					
021-040	0	44	25	9	0	89	37	33	25	33					
041-060	0	0	33	82	27	-	-	-	-	-					
061-080	0	0	25	9	73	-	-	-	-	-					
081-100	0	0	17	0	0	-	-	-	-	-					

*Datan were collected until 1994.

RHODODENDRON

MOLLE (BLUME) G. DON.

Family:	Ericaceae
English name:	Rhododendron or Azalea molle
French name:	Rhododendron molle
Synonyms:	<i>Rhododendron japonicum</i> , <i>Azalea mollis</i> , <i>Rhododendron sinense</i>
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This rhododendron of bushy habit can reach a height of 2 m. The young shoots and greyish winter buds are pubescent.

The 5-8 cm long deciduous leaves are borne on erect shoots. They are oblanceolate and pubescent on the undersides. They turn from soft green in summer to carmine red in fall.

The glabrous floral buds at the ends of the branches are conspicuous throughout winter. The flowers appear in late May, in large corymbs 5.0-7.5 cm in diameter. The funnel-shaped flowers unfold before or during leaf-out, at roughly the same time as the flowers of *Rhododendron roseum* and *Rhododendron calendulaceum*. They range in colour from yellow to orange-yellow to salmon, with a large orange basal spot, and have a rather unpleasant smell. The five stamens do not extend beyond the corolla.

The root system is dense, fibrous and rather shallow.

ORIGIN AND DISTRIBUTION

Introduced in 1823, *Rhododendron molle* is native to high mountains in China.

USE

Ornamental: This species, with its blazing colours, can be used as a specimen plant or be massed with other acid-loving plants. Its magnificent flowers and rarity make it an ideal choice for landscaping.

REQUIREMENTS

Cultural requirements are the same as for the other Ericaceae. A light, slightly sandy, moist soil with an acid pH (5.5) is required. This rhododendron prefers full sun, which ensures better growth and longer flowering. Yearly applications of an organic mulch such as pine needles or oak leaves will reduce soil moisture and temperature fluctuations.

During prolonged drought, the shrub must be watered regularly. Pruning involves removing the spent flowers.

DISEASES AND INSECTS

Rhododendrons are often affected by fungal diseases such as grey mould (*Botrytis*), root and collar rots (*Phytophthora*, *Sclerotinia* or *Pythium*) and powdery mildew.

Good cultural practices will reduce damage from weevils.

PROPAGATION

Cuttings: Semiripe cuttings, taken in mid-June and dipped in a hormone solution, generally give good results. According to some authors, the thin lateral shoots root better than the large terminal shoots, while others state that rooting is hastened by making a wound at the base of the cutting.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 4% cuttings (12 cm) were taken on June 11, 1990, from parent plants around 20 years old. The cuttings were dipped for 3 seconds in a 8,000 ppm-IBA/50 % ethanol solution, and then rinsed with tap water. They were then immersed in a fungicide bath (Benomyl-Captan®), planted in a peat-perlite mixture (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 50 % after 130 days. Misting was halted in early October and the seedlings were treated twice with soluble fertilizer (20-20-20, 200 ppm N) a week apart. In November, the seedlings were taken out of the rooting containers and put in the cold store at 0 °C in plastic bags perforated with a hatpin. In May 1991, the seedlings were potted up in Fertil Pot® filled with a peat-perlite mixture (3:2; v:v) and put in a tunnel greenhouse for roughly a month and a half, and then moved to outdoor cold frames provided with light shade. Weekly treatments with a soluble fertilizer (20-20-20, 200 ppm N) continued until mid-September. In November, they were put in the cold store at 0 °C. In May 1992, the seedlings were wrapped and returned to the cold store at 4 °C, to be shipped a few days later.

Inclusion in testing network: Seedlings 5-10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Very few seedlings died after transplanting, except at the two region 3 sites.

Region 1

At L'Assomption, no damage occurred during the trial.

At Sainte-Clotilde, 5 %, 50 % and 29 % of the shrubs died the first, third and fourth winters. The surviving plants had no damage.

At Saint-Hyacinthe, 5 %, 43 %, 88 % and 100 % of plants died the first four winters. The third winter, 12 % of shrubs suffered frost damage to the branch tips.

Region 2

At Sainte-Foy, one plant died during each of the third and fourth winters. Varied damage was observed: frost damage to the branch tips in 45 % and 50 % of seedlings the first two winters; frost damage to the floral buds in 75 % and 82 % of shrubs the third and fourth winters; damage to the one-year-old shoots in 20 % of seedlings the second winter; mechanical breakage to 30 % of shrubs the last winter; and rodent damage to 17 % of shrubs the third winter.

At Deschambault, mechanical breakage occurred in 17 %, 42 % and 100 % of shrubs the last three winters.

At La Pocatière, 67 % and 50 % of plants suffered frost damage to the old wood the first and third winters. The second winter, 11 % of plants suffered frost damage to the one-year-old shoots and 44 % suffered damage to the floral buds. The third winter, 8 % of shrubs suffered rodent damage. No damage occurred the last two winters.

Region 3

At Normandin, 9 % and 40 % of seedlings died the first two winters respectively. Frost damage to the branch tips occurred in 30 % of seedlings the second winter. The fifth winter, 80 % of plants had mechanical breakage.

At Kapuskasing, 60 %, 25 %, 33 % and 100 % of shrubs died the first four winters. The first three winters, 40 %, 50 % and 33 % of shrubs had damage to their aerial portions down to the ground level. The one-year-old shoots of one seedling were damaged the second winter.

and, the third winter, another shrub had frost damage to the branch tips.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

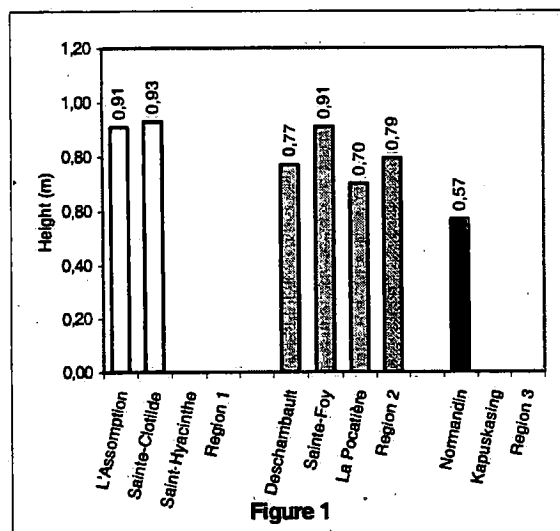


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

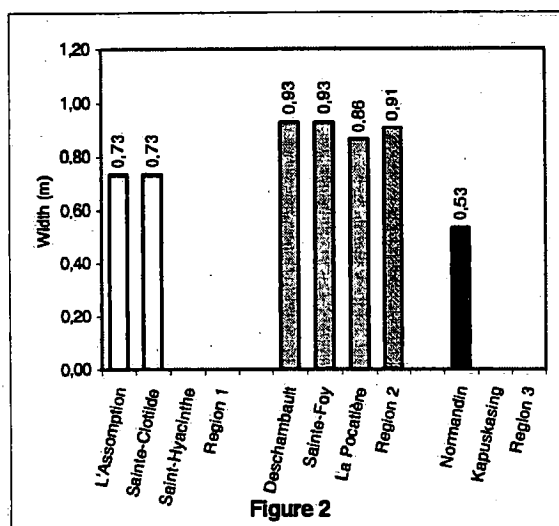


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

In general, the shrubs were taller in region 1 and wider in region 2. Growth was homogenous at region 2 sites.

Effect of pruning

The only extensive pruning done was at Kapuskasing, during the first few years.

Flowering

In region 1, the only flowering observed was at L'Assomption, where the first flowers appeared between May 24 and June 3 and flowering lasted 16-22 days. In region 2, flowering occurred every year on all plants; at La Pocatière, it began the first two weeks in June, while at the other sites, it began the first week of June. The duration of flowering in region 2 was 11-30 days depending on the year. In region 3, several plants flowered for two years at Normandin, with flowering beginning the week of June 10 and ending 18-29 days later.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings plants at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

No damage occurred at L'Assomption and only slight damage was observed at the zone 4b sites.

Production therefore depends on the presence of snow cover, particularly in the Montreal region, where the snow may disappear during the winter. An accumulation of snow early in the season favours production in zones 2b to 5.

HARDINESS EVALUATION

Since snow cover is a prerequisite for the survival of this species, as it is for many other rhododendrons, survival

may be compromised in zone 5, where the snow may be absent during cold periods. However, when adequately protected, the species can survive as far as zone 2b.

The species can be used in zones 2b to 5. However, the mechanical breakage observed shows that branches are fragile and susceptible to breakage under heavy snow accumulations.

The species achieved its full ornamental potential at Deschambault and L'Assomption.

The three parent plants are well established at the Éricetum (heath garden) at the Jardin Roger-Van den Hende. They are over 2 m tall, grow normally and have not suffered any winter damage for a number of years. However, they are planted in a sheltered location with ideal soil, and the snow cover, abundant early in fall, remains the entire winter.

BIBLIOGRAPHIC REFERENCES

3, 7, 31, 62, 64, 76

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Rhododendron molle* (Blume) G. Don. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		1	2	3	4	5	6	7	8	10	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	83								17		17
Saint-Hyacinthe	0								100		100
REGION 2											
Deschambault	68								32		32
Sainte-Foy	33	19	31	4				4	6	3	67
La Pocatière	64		8	2	24					2	36
REGION 3											
Normandin	68	6						10	16		32
Kapuskasing	0	8		6			31	55			100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 6 and 9 occurred for this species.

Table 2. Breakdown of *Rhododendron molle* (Blume) G. Don. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	8	8	8	100	92	80	55	0	100	100	67	56	-
041-080	0	0	92	92	8	0	8	20	45	40	0	0	33	44	-
081-120	0	0	0	0	84	0	0	0	0	60	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	60	0	0	0	100	45	25	0	0	100	89	8	9	0
041-080	0	40	100	100	58	0	55	75	30	27	0	11	92	83	92
081-120	0	0	0	0	42	0	0	0	70	73	0	0	0	8	8
REGION 3															
Height (cm)	Normandin					Kapusking*									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	75	33	17	0	100	100	100	100	-					
041-080	0	25	67	83	100	-	-	-	-	-					
081-120	-	-	-	-	-	-	-	-	-	-					

*At Saint-Hyacinthe and Kapuskasing, all plants were dead the fourth winter.

Table 3. Breakdown of *Rhododendron molle* (Blume) G. Don. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	83	8	8	100	100	75	5	0	100	100	85	56	-
041-080	0	0	17	92	58	0	0	25	95	58	0	0	15	44	-
081-120	0	0	0	0	34	0	0	0	0	42	0	0	0	0	-
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	100	17	0	0	100	95	25	0	0	100	100	17	0	0
041-080	0	0	83	75	34	0	5	75	50	27	0	0	83	83	42
081-120	0	0	0	25	58	0	0	0	50	55	0	0	0	17	58
121-160	0	0	0	0	8	0	0	0	0	18	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	100	67	17	20	100	100	100	100	-					
041-080	0	0	33	83	80	0	0	0	0	-					
081-120	-	-	-	-	-	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

*At Saint-Hyacinthe and Kapuskasing, all plants were dead the fourth winter.

RHODODENDRON 'RAMAPO'

Family:	Ericaceae
English name:	Ramapo Rhododendron
French name:	Rhododendron 'Ramapo'
Category:	Evergreen plant
Subdivision:	Shrub

The sections Botanical Description, Origin and Distribution, Use, Requirements, Diseases and Insects and Propagation can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume II (VR 221).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 410 cuttings (8 cm) were taken on June 28, 1988, from parent plants around 15 years old. The cuttings were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution, and then rinsed with tap water. They were then immersed in a fungicide bath (Benomyl-Captan®), planted in a peat-perlite mixture (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 40 % after 49 days and 78 % after 82 days. The seedlings were potted up on August 16 and September 19 in Fertil Pot® filled with a peat-perlite medium (3:2; v:v). Weekly treatments with a soluble fertilizer (20-20-20, 200 ppm N) continued until mid-September. The seedlings were kept in an unheated greenhouse until early November, when they were put in the cold store at 0 °C in plastic bags perforated with a hat pin. In May 1989, 360 seedlings were transplanted to the nursery, where they were grown on until May 1992. In May 1992, they were dug up, puddled, wrapped and placed in the cold store at 4 °C, to be shipped a few days later.

Inclusion in testing network: Seedlings 20 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one shrub died the fourth winter. Foliage browning occurred on a third of the plants the first and third winters. Frost damage to the floral buds was observed on all plants after the fourth winter. The following winter, two plants suffered mechanical breakage.

At Sainte-Clotilde, two shrubs died the third and fourth winters. No other damage occurred.

At Saint-Hyacinthe, 9 % and 68 % of plants died the first and third winters. Frost damage to the branch tips occurred in a third of the seedlings during the first winter. The third winter, 16 % of plants had foliage browning.

Region 2

In Sainte-Foy, two plants died during the first and second winters. One seedling suffered frost damage to the branch tips during the first winter.

At Deschambault, mechanical breakage occurred the last two winters in 67 % and 17 % of plants.

At La Pocatière, one shrub died the fourth winter and 50 % of plants had frost damage to the one-year-old shoots.

Region 3

At Normandin, one seedling died the first winter, but no other damage occurred.

At Kapuskasing, all the seedlings suffered damage. During the first two and last two winters, 5 %, 5 %, 18 % and 78 % of plants died. The one-year-old shoots were damaged in 52 %, 95 %, 91 %, 73 % and 22 % of shrubs during the five winters respectively. Two seedlings suffered frost damage to the entire aerial portion above the ground level during the first winter and one plant suffered foliage browning. The branch tips were damaged in 24 %, 9 % and 9 % of the shrubs during the first, third and fourth winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

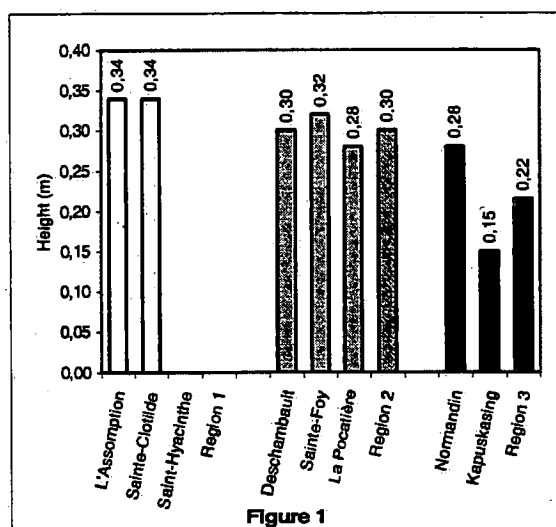


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

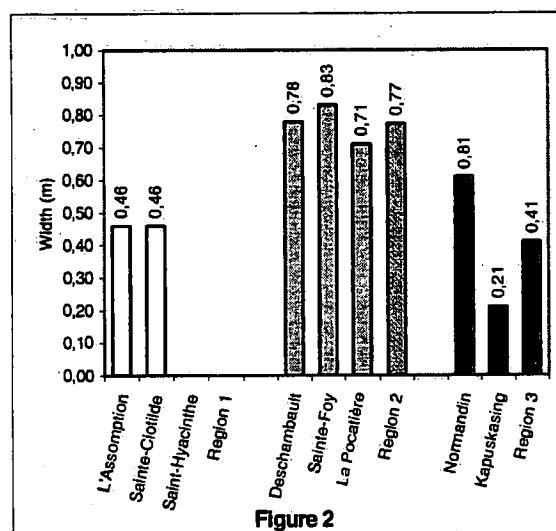


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Annual growth was very poor, particularly at Kapuskasing. The sizes reached were fairly homogenous at sites in regions 1 and 2. Maximum height was attained by the third year at L'Assomption and Saint-Hyacinthe. In addition, width growth exceeded height growth at all sites by the first year.

Effect of pruning

No significant pruning was done.

Flowering

In region 1, few or no shrubs flowered at the two sites on the south shore. At L'Assomption, flowering occurred every year, beginning between May 14 and 18; however, the duration of flowering decreased steadily over the five-year period, from 51 days to 8 days. At all the region 2 sites, flowering began in the last two weeks of May and lasted 13-24 days. In region 3, flowering was later (beginning between May 27 and June 2 at Normandin and between June 1 and 20 at Kapuskasing); at Kapuskasing, only three shrubs flowered the last year. In region 3, flowering lasted 9-20 days, depending on the year.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

This rhododendron grows wider than it does tall. Plants died in all the regions, particularly during the third and fourth years. At Kapuskasing, mortality was observed four out of the five years.

Production of this cultivar therefore depends on snow cover, especially in the Montreal region, where the snow can disappear during the winter. The production of the cultivar in zones 5 to 2b is facilitated by an accumulation of snow early in the season.

HARDINESS EVALUATION

According to the literature, *Rhododendron* 'Ramapo' tolerates temperatures down to -32 °C; tests carried out in 1987-92 showed that it can be used in zones 2b, 3 and 4. The most recent evaluation confirms that it can survive in zone 2b, as long as snow cover is present to ensure survival in fall and winter.

These tests confirm that the cultivar can be used in zones 2b, 3 and 4 but often suffers winter damage in zone 5 when there is no snow cover in winter.

The cultivar did not achieve its full ornamental potential at any site.

BIBLIOGRAPHIC REFERENCES

3, 4, 7, 62, 64

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Rhododendron* 'Ramapo' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage	
		WINTER DAMAGE ^a										
		1	2	3	4	5	6	7	8	10		14
REGION 1												
L'Assomption	63			18					2	4	13	37
Sainte-Clotilde	92								8			8
Saint-Hyacinthe	75		7						15		3	25
REGION 2												
Deschambault	83									17		17
Sainte-Foy	95		1						4			5
La Pocatière	88				10				2			12
REGION 3												
Normandin	99								1			1
Kapuskasing	1		8		67			2	21		1	99

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 5, 6, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Rhododendron* 'Ramapo' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
011-020	14	14	0	9	0	38	14	17	10	0	10	21	0	33	-
021-030	67	57	17	55	27	62	62	75	60	29	80	63	44	67	-
031-040	19	29	66	27	46	0	24	8	30	71	10	16	56	0	-
041-050	0	0	17	9	27	-	-	-	-	-	-	-	-	-	-
051-060	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-010	0	0	0	0	0	5	0	0	0	0	5	10	0	0	0
011-020	29	14	0	0	0	33	21	10	0	0	24	30	8	0	0
021-030	61	76	83	50	58	62	79	40	20	40	57	50	67	59	64
031-040	10	10	17	42	42	0	0	50	70	50	14	10	25	33	36
041-050	0	0	0	8	0	0	0	0	10	10	0	0	0	8	0
051-060	-	-	-	-	-	5	0	0	0	0	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-010	10	0	0	0	0	5	10	0	0	22					
011-020	66	55	0	25	8	43	40	55	91	78					
021-030	24	40	67	75	84	52	45	36	9	0					
031-040	0	5	33	0	8	0	5	9	0	0					
041-050	-	-	-	-	-	-	-	-	-	-					
051-060	-	-	-	-	-	-	-	-	-	-					

*Datan were collected until 1995.

Table 3. Breakdown of *Rhododendron* 'Ramapo' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	5	0	0	0	0	24	0	8	0	14	14	21	40	33	-
021-040	81	52	42	9	18	76	76	50	40	15	86	79	60	67	-
041-060	14	48	58	91	64	0	24	42	50	43	-	-	-	-	-
061-080	0	0	0	0	18	0	0	0	10	28	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
021-040	86	57	8	0	0	86	63	10	0	0	76	50	0	0	0
041-060	14	43	92	33	0	14	37	20	20	30	24	50	42	25	0
061-080	0	0	0	67	83	0	0	70	30	0	0	0	58	67	64
081-100	0	0	0	0	17	0	0	0	50	60	0	0	0	8	36
101-120	-	-	-	-	-	0	0	0	0	10	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-020	14	0	0	0	0	5	20	9	28	56					
021-040	81	35	8	25	8	76	70	91	72	44					
041-060	5	55	58	67	50	19	10	0	0	0					
061-080	0	10	34	8	42	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Data were collected until 1995.

RHODODENDRON VASEYI

A. GRAY.

Family:	Ericaceae
English name:	Pink Shell Azalea
French name:	Rhododendron vaseyi
Synonym:	<i>Azalea vaseyi</i>
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This deciduous rhododendron, irregular in form, grows to 3 m tall and wide under ideal conditions. It is in the subgenus *Anthodendron*.

The young shoots, slightly pubescent and soft green, turn brownish and then greyish with age.

The narrow pubescent leaves, oval to lanceolate in shape, are 13 cm long. Bright green in summer, they turn a beautiful reddish shade in fall.

The rounded flower buds form in late summer and are visible throughout the winter. Light green initially, they become dark green and then brown.

The pink funnel-shaped flowers are 3-5 cm in diameter. They appear in late April to mid-May, before the shrub leafs out. Flowering is later than in *Rhododendron dauricum* and earlier than in *Rhododendron* 'Ramapo'. Each inflorescence has 5-8 showy flowers, each comprising five petals and seven (sometimes five or six) stamens.

The root system is dense and shallow.

ORIGIN AND DISTRIBUTION

The species, native to North Carolina, was discovered by George Vasey and introduced in 1880. In its natural state, the shrub grows on tall cliffs in western North Carolina, where specimens almost 5 m tall have been observed.

USE

Ornamental: This shrub, with its spectacular flowers, is used as a specimen plant and in mass plantings of acid-loving plants. The red leaves in fall are also striking.

REQUIREMENTS

Cultural requirements are the same as for the other Ericaceae. A light, slightly sandy, moist soil with an acid pH (5.5) is required. This rhododendron prefers full sun, which ensures better growth and longer flowering. Yearly applications of an organic mulch such as pine needles or oak leaves will reduce soil moisture and temperature fluctuations, thus imitating the natural conditions under which the species thrives.

During prolonged drought, the shrub must be watered regularly. Pruning involves removing the spent flowers.

DISEASES AND INSECTS

Rhododendrons may be affected by fungal diseases such as grey mould (*Botrytis*), root and collar rots (*Phytophthora*, *Sclerotinia* or *Pythium*) and powdery mildew.

Good cultural practices will reduce damage from weevils.

PROPAGATION

Cuttings: Semi-woody cuttings, taken in late June and dipped in a rooting hormone solution, give good results, with root formation beginning 3-4 weeks later.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 432 cuttings (10 cm) were taken on June 22, 1990, from parent plants around 20 years old. The cuttings were dipped for 3 seconds in a 8,000-ppm IBA/50 % ethanol solution, and then rinsed with tap water.

They were then immersed in a fungicide bath (Benomyl-Captan®), planted in a peat-perlite mixture (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 55 % after 130 days. Misting was halted in early October and the seedlings were treated twice with soluble fertilizer (20-20-20, 200 ppm N). In November, the seedlings were taken out of the rooting containers and put in the cold store at 0 °C in plastic bags perforated with a hatpin. In May 1991, the seedlings were potted up in Fertil Pot® filled with a peat-perlite mixture (3:2; v:v) and put in a tunnel greenhouse for roughly a month and a half, and then moved to cold frames provided with light shade. Weekly treatments with a liquid fertilizer (20-20-20, 200 ppm N) continued until mid-September. In November, they were put in the cold store at 0 °C. In early May 1992, the seedlings were wrapped and returned to the cold store at 4 °C, to be shipped a few days later.

Inclusion in testing network: Seedlings 7 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Survival after transplanting was very poor at all the sites for several reasons: dried-out root balls and inappropriate soil conditions at the time of planting.

In addition, a large number of seedlings died during the first winter, probably due to their failure to fully recover from transplanting. Only a few plants survived at five sites; the details of the main types of damage that occurred to the shrubs each winter are described below.

Region 1

At L'Assomption, the three seedlings that survived the first winter died the third winter.

At Sainte-Clotilde, two of the five plants that survived the first winter went on to die the third winter. No other damage occurred.

Region 2

At Sainte-Foy, seven seedlings survived the first winter. The third and fourth winters, two and four shrubs respectively had frost damage to the floral buds. In addition, one shrub suffered rodent damage the third winter.

At Deschambault, 3 of the 11 plants that survived the first winter died the fourth winter. Frost damage to the branch tips occurred in single shrub the second, fourth and fifth winters. The one-year-old shoots were affected in one plant the second winter and another plant had damage to the old wood during the following winter. Mechanical breakage was observed during the last three winters in 10 %, 22 % and 33 % of shrubs.

Region 3

At Normandin, two of the seven seedlings that survived the first winter died the second winter and another succumbed the fifth winter. Five plants had frost damage to the branch tips the second winter and four of these had mechanical damage the last winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

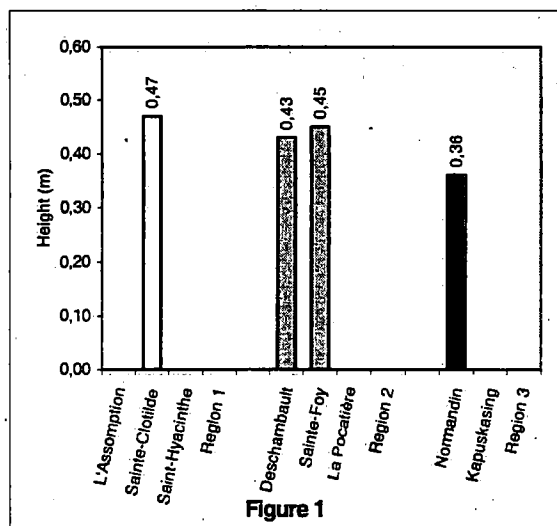


Figure 1. Mean height of shrubs at trial's end at each of the eight sites

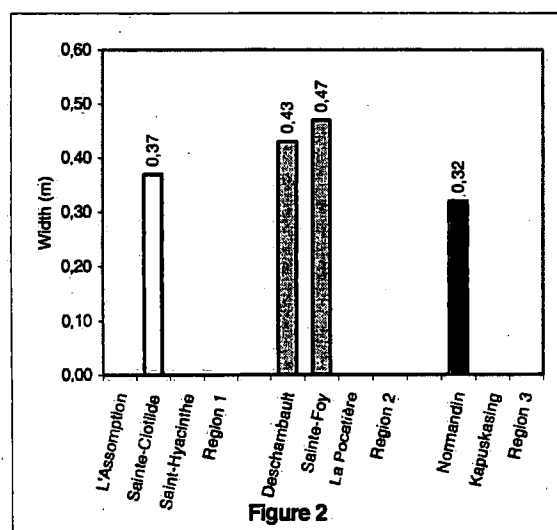


Figure 2. Mean width of shrubs at trial's end at each of the eight sites

Height growth was very homogenous at all sites.

Effect of pruning

No pruning was done, except at Normandin, where the shrubs were cut back by one third during the last two years.

Flowering

No flowering occurred in the Montreal region. In regions 2 and 3, a few plants flowered from late May to early June for 7-16 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

This species was much more sensitive to soil conditions in the amended plots than the other Ericaceae evaluated concurrently (*Rhododendron* 'Ramapo', *R. canadense*, *R. molle* and *Calluna vulgaris* 'Golden Carpet').

Production of this species is not recommended in the hardiness zones that are very cold; even though some shrubs survived the winters at Normandin, the gradual mortality observed there showed that the plants were weakening with time.

In the warmest areas, production is also risky since the snow cover may disappear for periods during winter or may be late getting established in fall.

In hardiness zone 4, seedlings died at the beginning of the trial at all the sites and, at some sites, plants died during the trial itself. At Sainte-Foy, the seedlings that survived the first winter showed no significant damage subsequently and grew normally. Therefore, production of the species must be done in containers, with shelter provided during the winter.

Planting older seedlings ensures the best chances of long-term survival.

HARDINESS EVALUATION

Survival after transplanting in this species was problematic, with many seedlings dying the first season. In addition, a number of seedlings that failed to fully recover from transplanting died during the first winter. The remaining surviving seedlings either suffered light damage to their aerial portions or died, indicating that the root system does not tolerate the cold well.

According to the literature, *Rhododendron vaseyi* is hardy to zone 4. The tests confirm that plants will survive in zone 4, given a sufficient snow cover to ensure fall and winter survival. They also showed that the species' ability to tolerate climatic conditions in zone 5 is linked to the presence of the snow cover during the winter and whether the species' special soil requirements are met.

Given the wide range of results obtained and the high mortality of seedlings after transplanting and during the first winter, it is impossible to draw any other conclusions about the species' hardiness or survival.

The parent plant, well established at the Ericacetum (heath garden) of the Jardin Roger-Van den Hende, is almost 2 m tall, grows normally and has shown no frost damage for a number of years. However, it is planted in a site protected from the wind, where the soil conditions are ideal and where the snow cover, abundant early in fall, remains for the entire winter.

Full ornamental potential was not achieved at the sites tested.

BIBLIOGRAPHIC REFERENCES

3, 7, 31, 62, 64, 76

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Rhododendron vaseyi* A. Gray. from 1993 to 1997

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	50							50				50
Sainte-Clotilde	92							8				8
Saint-Hyacinthe	0							100				100
REGION 2												
Deschambault	69	8		2	2			6		13		31
Sainte-Foy	80		17								3	20
La Pocatière	0							100				100
REGION 3												
Normandin	58	14						12		16		42
Kapuskasing	0							100				100

^a Key:

- 1 = no damage
 2 = damage to the tip of the previous year's shoot
 3 = frost damage on the flower buds
 4 = previous year's shoot affected
 5 = old wood affected
 6 = dead down to the level of snow cover

- 7 = dead down to the ground surface
 8 = dead
 9 = sunscald, trunk spitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of type 6, 7 and 9 occurred for this species.

Table 2. Breakdown of *Rhododendron vaseyi* A. Gray. plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption*					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	67	33	0	-	-	100	66	21	0	-	64	0	-	-	-
021-040	33	67	100	-	-	0	34	74	50	-	36	100	-	-	-
041-060	-	-	-	-	-	0	0	5	50	-	-	-	-	-	-
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	84	45	10	0	0	86	57	14	0	0	100	-	-	-	-
021-040	16	45	80	80	33	14	43	72	43	29	-	-	-	-	-
041-060	0	10	0	10	50	0	0	14	43	71	-	-	-	-	-
061-080	0	0	10	10	0	0	0	0	14	0	-	-	-	-	-
081-100	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-020	50	17	0	0	0	100	-	-	-	-					
021-040	50	67	0	60	50	-	-	-	-	-					
041-060	0	16	100	40	50	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

*At L'Assomption, Saint-Hyacinthe, La Pocatière and Kapuskasing, all plants were died after first, second and third winters and at Sainte-Clotilde, datas were collected on four years only.

Table 3. Breakdown of *Rhododendron vaseyi* A. Gray. plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption*					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	100	67	67	-	-	100	67	15	0	-	100	100	-	-	-
021-040	0	33	33	-	-	0	33	85	75	-	-	-	-	-	-
041-060	-	-	-	-	-	0	0	0	25	-	-	-	-	-	-
061-080	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	92	73	30	30	0	100	86	28	0	0	100	-	-	-	-
021-040	8	27	70	70	34	0	14	57	14	43	-	-	-	-	-
041-060	0	0	0	0	66	0	0	15	86	43	-	-	-	-	-
061-080	-	-	-	-	-	0	0	0	0	14	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-020	100	67	0	0	0	100	-	-	-	-					
021-040	0	17	80	80	50	-	-	-	-	-					
041-060	0	16	0	20	50	-	-	-	-	-					
061-080	0	0	20	0	0	-	-	-	-	-					

*At L'Assomption, Saint-Hyacinthe, La Pocatière and Kapuskasing, all plants were died after first, second and third winters and at Sainte-Clotilde, data were collected on four years only.

Rosa 'JOHN DAVIS'

Family:	Rosaceae
English name:	John Davis Rose
French name:	Rosier 'John Davis'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This rose, of prostrate growth habit, has grown to 2.0 m high and 2.5 wide in Ottawa.

The abundant, shiny foliage is borne on reddish trailing canes with straight, erect thorns. The leaves are light green with purple outer edges.

The medium-pink double flowers are yellow at the base and have a light spicy fragrance. The blooms are 8-9 cm in diameter and have 40-50 petals. They are of a quartered form similar to many old-fashioned roses and occur in clusters of 15-17 flowers. This rose generally blooms in late June, and then intermittently through late summer.

ORIGIN AND DISTRIBUTION

Introduced in 1986, this rose in the Explorer™ Series was created by Dr. Felicitas Svejda. It is the result of the double open pollination of a seedling from a cross between *Rosa x kordesii* Wulff. and an unnamed breeding line originating from a cross between 'Red Dawn' and 'Suzanne'.

USE

Ornamental: This shrub can be used as a tall groundcover or planted along a fence or in front of a foundation.

REQUIREMENTS

In general, roses need a sunny, airy spot; a minimum of 5-6 hours of sunshine per day is required to obtain vigorous plants that flower well. The ideal site will have early

morning sun that burns off the dew (dew on the foliage can promote foliar diseases).

This rose is adapted to different soils. It prefers soil rich in organic matter but will also grow well in clay or even sandy soil enriched with organic matter. Good drainage is essential, since this rose does not tolerate an accumulation of water around its roots. The ideal soil pH is slightly acid (around 6.5), which promotes the proper balance of soil minerals.

Training is required during the first few years after planting. To ensure recurrent and abundant flowering, roses must be deadheaded. Portions damaged by the cold or other factors must be cut back. Old specimens must be renewed from time to time.

DISEASES AND INSECTS

Information on the main pests and diseases affecting the rose can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volumes II and III, Appendix I, Pathology and Insects on Roses (VR 221 and VT 008).

This rose is highly resistant to blackspot and powdery mildew.

PROPAGATION

This cultivar is easily propagated from cuttings or grafts. Roses propagated on their own rootstocks are reputed to flower better.

Cuttings: Softwood cuttings are generally used in conjunction with a hormone rooting powder with 2,500-6,000-ppm IBA. Dipping the base of the cutting for 5 seconds in a 4,000-ppm IBA solution is also done.

Rose cuttings are very susceptible to rot and special care must be taken to ensure the cleanliness of tools and work tables and to use sterile containers and substrate. A fungicide may be required when a mist unit is used.

The survival rate for 'John Davis' seedlings propagated from cuttings is excellent.

Grafting: Grafting is done by T-budding; the grafts are planted in nursery beds in early August. Generally, *Rosa multiflora* is used as the rootstock.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 265 cuttings (10 cm) were taken on June 26, 1989, from roughly five-year-old parent plants. The cuttings were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. They were then immersed in a fungicide solution (Benomyl-Captan®) and planted in a peat-perlite mixture (2:3; v:v) and then placed under a mist unit (Mist-A-Matic®). The rooting rate was 98 % after 49 days. On August 15, the seedlings were potted up in Fertil Pot® in a peat-perlite mixture (3:2; v:v) and treated weekly with a soluble fertilizer (20-20-20) until mid-September. They were kept in an unheated greenhouse until mid-November, when they were put in the cold store at 0 °C in plastic bags perforated with a hatpin. In May 1990, 250 seedlings were transplanted to the nursery where they were grown on until May 1991. They were then dug up, puddled, wrapped and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Seedlings pruned back to a height of 5-11 cm were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, all plants suffered frost damage to the branch tips the first three winters; the following winter, the percentage decreased to 64 %. The last winter, 37 % of shrubs suffered frost damage to the aerial portion above the snow cover.

At Sainte-Clotilde, 35 % of plants sustained no damage during the first two winters, while the same percentage had frost damage to the previous year's shoots the following two winters. All the remaining shrubs suffered frost damage to the branch tips every winter.

At Saint-Hyacinthe, 62 % of shrubs had frost damage to the branch tips the first and third winters. No damage occurred the second, fourth and fifth winters.

Region 2

At Deschambault, 75 % of shrubs had frost damage to the previous year's shoots the third winter. The first two winters, 81 % and 57 % of the roses suffered no damage while, the last two winters, 75 % of plants had frost damage to the branch tips.

At Sainte-Foy, 90 % and 100 % of plants had no damage the first and last winters. However, the second winter, 60 % had frost damage to the aerial portion above snow level and, the fourth winter, 33 % had rodent damage.

At La Pocatière, winter damage was limited to the branch tips, occurring in 10 %, 50 % and 100 % of roses the second, third and fourth winters.

Region 3

At Normandin, 75-100 % of shrubs had damage to the entire aerial portion above the snow cover during the last four winters. One shrub died the fourth winter.

At Kapuskasing, 10 % of plants died during the trial and mortality was progressive over the five years. Frost damage to the previous year's shoots occurred in 60 % of shrubs the last three winters and, on average, 20 % of the roses had frost damage to the entire aerial portion above the soil level four out of the five winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

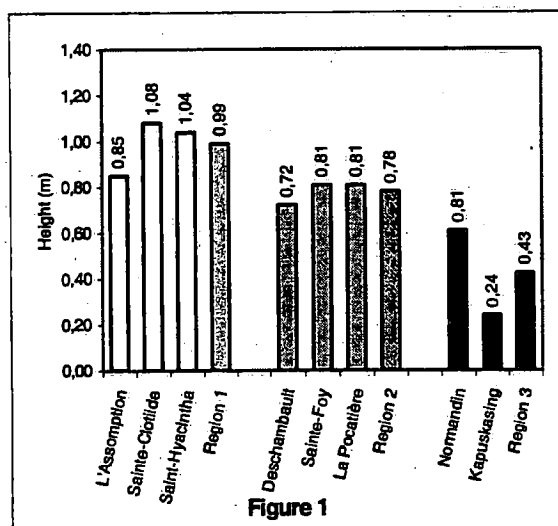


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

At Saint-Hyacinthe, Sainte-Foy, Deschambault and Normandin, the shrubs attained their final maximum height at the end of the third year, while at Sainte-Clotilde, L'Assomption and La Pocatière, this occurred at the end of the fourth growing season. At Kapuskasing, the plants reached their peak height at the end of the first growing season, with further growth being suppressed by significant freezing of the aerial portions every winter.

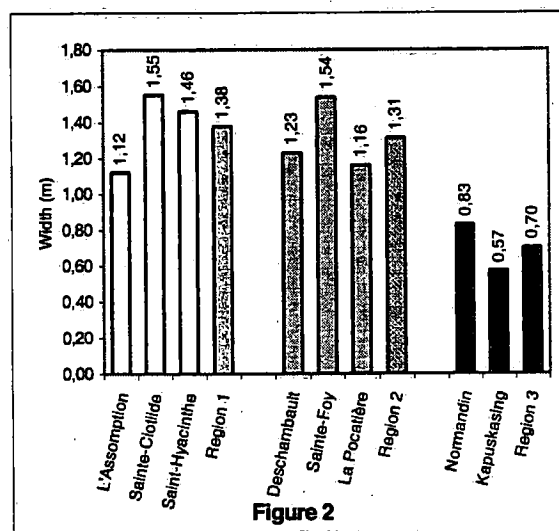


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Most plants did not attain their maximum width after five years, since growth increased every year. At Normandin, however, no gains appear to have been made after the second growing season.

Effect of pruning

The extent of pruning varied greatly in each region. Every year, plants were cut back by 10-50 % in height at the region 1 sites, by 10-30 % at Deschambault and La Pocatière, and by 66-75 % at Sainte-Foy the second and third winters. In both region 3 sites, plants were cut back by over 50 % every year.

Flowering

Flowering occurred every year on all plants at every site, regardless of the conditions the previous winter.

In region 1, flowering began around June 19 every year, or 4-5 days later than in 'John Cabot'. In regions 2 and 3, the first flowers appeared 5-6 days later.

The duration of flowering was similar at all sites, ranging from 50 to 70 days. Depending on the year and specific conditions, flowering lasted as long as 95-100 days at L'Assomption, Sainte-Foy and Saint-Hyacinthe.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

The shrubs were wider than they were tall by trial's end at all sites. At Normandin, Sainte-Clotilde and Saint-Hyacinthe, 90-100 % of plants were over 1 m tall after two growing seasons, while at Deschambault, Sainte-Foy and La Pocatière, a third growing season was required to reach this height. At L'Assomption, four growing seasons were required. At Kapuskasing, no rose grew over 25 cm tall.

Since this rose produces trailing canes and has greater width than height growth, it can be produced fairly quickly in zones 2b, 4 and 5 and can be sold after two growing seasons.

HARDINESS EVALUATION

Due to the extent of winter damage, the very low annual growth and high mortality every year in zone 2a, the cultivar most likely cannot survive in zone 2a. In 2b, it can survive as long as the base is protected by adequate snow cover.

The rose can be used as far as zone 2b, since mortality there was accidental. However, in this hardiness zone, portions of the canes that were not protected by the snow cover during the coldest part of the winter succumbed completely to frost damage. After being pruned back severely to nearly ground level, however, the roses grew

back, produced many canes and flowered abundantly. Flowering duration was reduced by several weeks during the years the roses had to be cut back all the way to the ground. In zones 4 and 5, very few roses suffered damage more severe than frost injury to the branch tips. Growth was regular and size increased every year.

The rose can only achieve its full ornamental potential in zones outside of those tested.

BIBLIOGRAPHIC REFERENCES

2, 7, 24, 61, 71

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Table 1. Frequency of winter damage observed on Rosa 'John Davis' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	10	11		
REGION 1											
L'Assomption	13	80			7					87	
Sainte-Clotilde	15	72	13							85	
Saint-Hyacinthe	74	26								26	
REGION 2											
Deschambault	36	47	15	2						64	
Sainte-Foy	57	22			15				6	43	
La Pocatière	68	32								32	
REGION 3											
Normandin	25				73		2			75	
Kapuskasing	15	18	40			17	10			85	

^aKey:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 10 occurred for this cultivar.

Table 2. Breakdown of Rosa 'John Davis' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	57	50	0	0	86	5	0	0	0	-	5	0	0	0
051-100	0	43	50	100	82	14	95	75	50	50	-	90	75	67	50
101-150	0	0	0	0	18	0	0	25	42	50	-	5	25	33	50
151-200	-	-	-	-	-	0	0	0	8	0	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	48	8	0	0	100	71	8	0	0	75	40	8	0	0
051-100	0	48	92	100	100	0	29	92	75	100	25	60	92	75	92
101-150	0	4	0	0	0	0	0	0	25	0	0	0	0	25	8
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	100	0	17	25	0	100	100	100	100	100					
051-100	0	100	66	75	100	-	-	-	-	-					
101-150	0	0	17	0	0	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of Rosa 'John Davis' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	58	11	0	0	0	33	24	0	0	0	-	0	0	0	0
051-100	42	89	75	100	18	67	71	67	0	0	-	24	0	8	0
101-150	0	0	25	0	73	0	5	33	42	50	-	37	75	92	67
151-200	0	0	0	0	9	0	0	0	50	42	-	35	25	0	33
201-250	-	-	-	-	-	0	0	0	8	8	-	4	0	0	0
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	10	0	0	0	0	19	0	8	8	0	55	15	0	0	0
051-100	85	52	33	33	17	81	48	83	92	0	45	70	42	25	25
101-150	5	48	67	67	83	0	52	9	0	50	0	15	58	75	75
151-200	-	-	-	-	-	0	0	0	0	42	-	-	-	-	-
201-250	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapusksing									
	91	92	93	94	95	91	92	93	94	95					
001-050	38	0	0	0	0	100	85	73	90	50					
051-100	57	5	92	25	100	0	15	27	10	50					
101-150	5	67	8	42	0	-	-	-	-	-					
151-200	0	28	0	33	0	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Rosa 'J.P. CONNELL'

Family:	Rosaceae
English name:	J.P. Connell Rose
French name:	Rosier 'J.P. Connell'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This rose, with its upright growth habit, can reach a height of 0.90-1.25 m and a width of 0.80-1.20 m.

The abundant, glossy foliage is dark green in colour.

Initially, the lemon yellow flowers have a raised centre. As they open and the stamens become exposed, the flowers gradually fade to pale yellow, then creamy white before withering. The flowers resemble those of a hybrid tea rose. They appear singly or in racemes of 3-8 and measure 7-9 cm across. In the first two years, the plants flower sparsely; however, once they are three to four years old, they flower profusely in June, with smaller numbers of flowers appearing during the rest of the season.

ORIGIN AND DISTRIBUTION

This rose in the Explorer Series™ was created by Dr. Felicitas Svejda and licensed in 1987. Although originally not included in that Series, the J.P. Connell Rose and all of Ms Svejda's other roses were eventually grouped together as part of a new marketing approach. The rose originated from a cross between the floribunda 'Arthur Bell' and a seedling obtained from a shrub rose, the 'Von Scharnhorst'.

USE

Ornamental: This rose can be used as a specimen or in foundation plantings and along fences.

REQUIREMENTS

In general, roses require a sunny, airy spot: a minimum of 5-6 hours of sunshine per day is required to produce vigorous plants that flower well. The ideal site will have early morning sun that burns off the dew (dew on the foliage can promote foliage diseases).

This rose is adapted to different soils. It prefers soil rich in organic matter, but will also grow well in clay or even sandy soil enriched with organic matter. Good drainage is critical, since this rose does not tolerate an accumulation of water around its roots. The ideal soil pH is slightly acid (around 6.5), which promotes the proper balance of soil minerals.

Training is necessary during the first few years after planting. To ensure recurrent and abundant flowering, roses must be deadheaded. Pruning is also required in the spring to remove dead or damaged wood.

DISEASES AND INSECTS

Information on the main pests and diseases affecting the rose can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volumes II and III, Appendix I, Pathology and Insects on Roses (VR 221 and VT 008).

This rose has excellent resistance to powdery mildew, but is susceptible to blackspot, so it will lose much of its foliage unless protected against this pathogen.

The plants at warmer, wetter sites were affected by blackspot (L'Assomption, Sainte-Clotilde, Saint-Hyacinthe and Deschambault).

PROPAGATION

This cultivar can be easily propagated from cuttings or grafts. Roses propagated on their own rootstocks are reputed to flower better.

Cuttings: Softwood cuttings are a proven technique, and a hormone powder with a 2,500 to 6,000-ppm IBA

concentration is recommended for this purpose. Dipping the base of the cuttings for five seconds in 4,000-ppm IBA solution is also done.

Rose cuttings are very susceptible to rot and special care must be taken to keep tools and work tables clean. It is essential to use a sterile medium and sterile containers. A fungicide may be required if cuttings are misted.

Grafting: Grafting is done by T-budding; the grafts are planted in nursery beds in early August. The rootstock used is generally *Rosa multiflora*.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 460 cuttings (10-15 cm) with two or three nodes were taken on July 26, 1990 from two-year-old parent plants about 50 cm tall and 25 cm wide. The cuttings were dipped in a 5,000-ppm IBA/50 % ethanol solution for five seconds. The cuttings were planted in peat containers filled with sand and perlite (2:1; v:v) and placed under the mist unit (Mist-A-Matic®). A Benomyl®-based fungicide was applied weekly throughout the propagation period. The rooting rate was 70 % after eight weeks. The seedlings were kept in their rooting containers, but a number of them died before the end of the season; the 170 remaining seedlings were placed in the cold store at 4 °C on October 23. Owing to early budbreak, the plants had to be transferred to a greenhouse on April 12, 1991, and soluble fertilizer (20-20-20) was applied at the rate of 200 ppm. The seedlings were packed in plastic bags prior to shipping.

Inclusion in testing network: Seedlings 20 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, all the seedlings suffered frost damage to the aerial portions down to the snow cover every winter.

In Sainte-Clotilde, 14 %, 6 % and 8 % of the plants died during the first two winters and the fourth winter. The last two winters, 8 % and 18 % of the roses suffered no damage. During the first three winters, 53 %, 95 % and 67 % of the plants had frost damage to their aerial portions down to the snow cover. Frost damage to the old wood, the previous year's shoots and branch tips occurred in all the other plants every winter.

At Saint-Hyacinthe, 7 % of the seedlings died the first winter. All of the shrubs suffered frost damage to the branches above the snow cover the first two winters. The following winter, a third of the plants had no damage, another third had frost damage to branch tips and the remaining third had damage to the previous year's shoots. No damage occurred the fourth winter, and only 33 % of the roses had frost damage to branch tips in the last winter.

Region 2

At Deschambault, 11 %, 22 % and 15 % of the plants died because of the weather conditions during the second winter and the last two winters. The second and fourth winters, 36 % and 22 % of the roses froze to the ground. In addition, all the other roses suffered frost damage to the current year's shoots and to the branch tips during the other winters.

At Sainte-Foy, 100 % of the plants sustained frost damage to the aerial portions down to the snow cover during the second, third and fourth winters. All the other roses suffered frost damage to the previous year's shoots or to branch tips during the trial. In addition, two replications were completely wiped out by voles.

In La Pocatière, 47 % of roses showed no damage following the first winter. Damage was limited to freezing of branch tips in 53 %, 32 %, 67 % and 100 % of roses the first two and last two winters. In addition, damage from mechanical breakage caused by the weight of snow occurred in 33 % of plants the fourth winter.

Region 3

At Normandin, one seedling died the third winter. All the roses had damage to the previous year's shoots the first winter. All the other plants suffered frost damage to the old wood or to the aerial portions above the snow cover during the last four winters.

At Kapuskasing, 7 % and 20 % of the plants died the second and third winters. The first two winters, most of the plants showed frost damage to branch tips. Subsequently, all the roses suffered damage to the old wood or to the entire above-ground portion.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

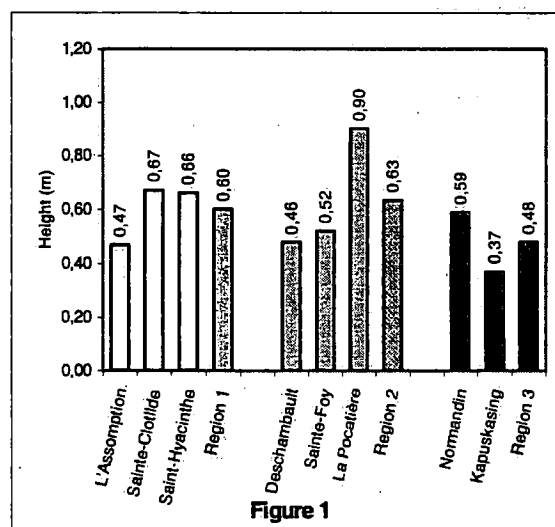


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

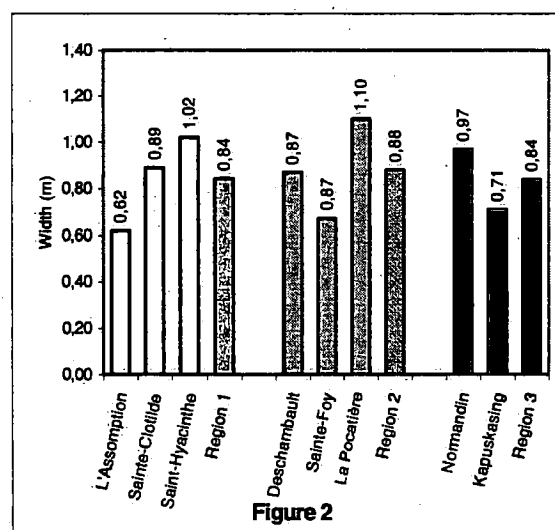


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Effect of pruning

Extensive pruning was done at all sites every spring; it involved removing more than 50 % of the previous year's shoots because of heavy frost damage. This pruning had little or no effect on the species' flowering characteristics.

Flowering

The first flowers appeared between June 12 and 15 in region 1; 8 to 10 days later in region 2; and during the last week of June or the first week of July in region 3. At all sites in regions 1 and 2, the first period of flowering ended in late July and lasted 25 to 35 days. Occasionally a second, less intense, period of flowering occurred, lasting some 65 to 90 days ending in late September. In region 3, the start of flowering varied widely from one season to the next, but it continued for 50 to 60 days non-stop.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

The poor growth observed at Deschambault is attributable to excessive soil moisture in the plot.

The shrubs were taller than they were wide at trial's end at all sites. At Saint-Hyacinthe, the roses reached a much taller final height than at the other sites, showing that growing conditions were more favourable and better suited to this rose. After two growing seasons, all sites produced shrubs 0.50-1.00 m tall. This rose can be grown in all hardiness zones, but must be pruned severely every year to counteract frost damage.

HARDINESS EVALUATION

There was considerable winter damage at all sites, regardless of the hardiness zone. Shrub mortality occurred every winter in all zones tested, from the warmest to the coldest. This rose needs the protection afforded by snow cover early in the fall and throughout the winter. It can

survive as far as zone 2b, provided it has a sufficient snow layer around its base.

This rose's potential usefulness extends as far as zone 2b, where plant mortality was random. However, in all hardiness zones frost destroyed all the aerial portions of the shrubs above the snow cover during the coldest period of the winter. After severe pruning, this rose grows back from ground level, produces numerous stems and flowers spectacularly. The period of flowering is a few weeks shorter, however, in years where it has to be cut back to the ground.

Full ornamental potential was achieved only outside the zones tested.

BIBLIOGRAPHIC REFERENCES

2, 4, 24, 26, 28, 36, 38, 61, 70

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Rosa 'J.P. Connell'* from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	0					100						100
Sainte-Clotilde	5	24		9	14	43		5				95
Saint-Hyacinthe	40	13				45		2				60
REGION 2												
Deschambault	4	26		41			18	11				96
Sainte-Foy	0	28		12		60						100
La Pocatière	9	51				34				6		91
REGION 3												
Normandin	0	0		20	5	65		2		8		100
Kapuskasing	0	23		52			19	6				100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Rosa* 'J.P. Connell' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	75	17	10	0	0	43	48	17	8	0	-	0	0	0	0
051-100	25	83	90	90	30	57	52	50	82	72	-	7	0	8	0
101-150	0	0	0	10	70	0	0	33	10	28	-	40	50	58	33
151-200	-	-	-	-	-	-	-	-	-	-	-	53	50	34	67
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	83	70	67	43	21	0	0	0	0	74	5	0	0	0
051-100	0	17	30	33	57	79	32	67	47	50	26	80	100	67	33
101-150	-	-	-	-	-	0	68	33	53	50	0	15	0	33	67
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	16	8	9	0	0	93	0	36	11	0					
051-100	84	92	27	90	30	7	100	64	78	100					
101-150	0	0	46	10	70	0	0	0	11	0					
151-200	0	0	18	0	0	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of Rosa 'J.P. Connell' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	58	30	10	0	62	95	50	42	36	-	0	0	0	0
041-080	0	42	60	90	90	38	5	42	50	64	-	33	25	16	8
081-120	0	0	10	0	10	0	0	8	8	0	-	54	66	75	58
121-160	-	-	-	-	-	-	-	-	-	-	-	13	9	9	17
161-200	-	-	-	-	-	-	-	-	-	-	-	0	0	0	17
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	95	100	80	100	86	0	0	0	0	0	95	0	0	0	0
041-080	5	0	20	0	14	26	11	75	75	25	5	100	83	92	100
081-120	-	-	-	-	-	74	89	16	25	0	0	0	17	8	0
121-160	-	-	-	-	-	0	0	9	0	42	-	-	-	-	-
161-200	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	92	0	9	0	0	93	0	27	44	0					
041-080	8	50	9	10	20	7	100	73	56	89					
081-120	0	50	73	70	80	0	0	0	0	11					
121-160	0	0	9	20	0	-	-	-	-	-					
161-200	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

ROSA 'LOUIS JOLLIET'

Family:	Rosaceae
English name:	Louis Jolliet Rose
French name:	Rosier 'Louis Jolliet'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This rose can grow to 1.2 m tall.

The trailing canes bear numerous leaves composed of oval leaflets with dentate margins. The coppery, dark green foliage is shiny and turns yellow in fall.

The dark pink floral buds unfold into flowers with dark pink petals that gradually fade. The flowers, in racemes of 3-10, are 7 cm in diameter and have a spicy fragrance. Each flower has roughly 38 petals, with the outer petals longer and the central petals shorter and often twisted. The abundant flowering in June persists until the first killing frost.

The shrub produces bright red spherical hips.

The many roots make the cultivar a vigorous grower.

ORIGIN AND DISTRIBUTION

This cultivar is the result of a cross between [(*Rosa x kordesii* X (open pollination of 'Max Graft'))] as the female plant and [*Rosa x kordesii* X ('Red Dawn' x 'Suzanne') X 'Champlain'] as the pollen. It is part of the Explorer™ Series developed by Dr. Felicitas Svejda and licensed in 1990.

USE

Ornamental: This prolific flowerer can be used alone or in association with other roses.

REQUIREMENTS

In general, roses require a sunny, airy spot; a minimum of 5-6 hours of sunshine per day is required to obtain vigorous plants that flower well. The ideal site will have early morning sun that burns off the dew (dew on the foliage can promote foliar diseases).

This rose is adapted to different soils. It prefers soil rich in organic matter but will also grow well in clay or even sandy soil enriched with organic mater. Good drainage is essential, since this rose does not tolerate an accumulation of water around its roots. The ideal soil pH is slightly acid (around 6.5), which promotes the proper balance of soil minerals.

Training is required during the first few years after planting. To ensure recurrent and abundant flowering, roses must be deadheaded. Pruning is required in the spring to remove dead or damaged wood.

DISEASES AND INSECTS

Information on the main pests and diseases affecting the rose can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volumes II and III, Appendix I, Pathology and Insects on Roses (VR 221 and VT 008).

PROPAGATION

Cuttings: Semi-woody cuttings, treated with a growth regulator (powder or solution), will form a root system in 4-6 weeks.

Rose cuttings are very susceptible to rot and special care must be taken to ensure the cleanliness of tools and work tables. A fungicide may be required when a mist unit is used.

Young cuttings react poorly to pricking out and it is recommended that they be overwintered in their propagation containers and then be transplanted after they leaf out in spring.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (5 cm) were taken on August 2, 1990, from one-year-old parent plants measuring roughly 30 cm tall and 10 cm wide. The cuttings were dipped for 5 seconds in a 5,000-ppm IBA/50 % ethanol solution. They were then placed in plug trays filled with Promix® and sand (1:2; v:v) and placed under a mist unit (Mist-A-Matic®). The heating cables was set at 25 °C. Weekly fungicide treatments (Benomyl®) were provided throughout the propagation period. The rooting rate was 66 % after 18 days. On August 20, the seedlings were placed in the lathhouse and fertilized with a 10-52-10 solution at the recommended rate. In the fall, they were placed in the cold store. Due to early budbreak, they were placed in the greenhouse on March 13, 1991, and, on May 22, transplanted to the nursery. In October, they were dug up, puddled and heeled in for the winter. In April 1992, they were wrapped and put in the cellar to await shipping in May.

Inclusion in testing network: Seedlings 5-10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, two shrubs died the last winter. All plants suffered frost damage during the five winters, at varying intensities depending on the year. Frost damage to the branch tips occurred in 100 %, 65 %, 100 % and 100 % of plants during the first four winters. During the second winter, all the seedlings in the first replication suffered frost damage to the aerial portion above the snow cover and 83 % of plants were damaged by rodents the last winter.

At Sainte-Clotilde, all the plants survived. Frost damage to the previous year's shoots occurred in 25 %, 100 %, 33 %, 100 % and 67 % of shrubs during the five winters. Frost damage to the branch tips was observed the first and third winters in 17 % and 67 % of shrubs. The last winter, 33 % of roses had frost damage to the old wood. In addition, 25 % of shrubs suffered rodent damage the first winter.

At Saint-Hyacinthe, two seedlings died the first winter. Frost damage to the branch tips was observed in 100 %, 100 % and 67 % of plants during the second, third and fourth winters. The last winter, one shrub suffered frost damage to the old wood and the others suffered rodent damage.

Region 2

At Sainte-Foy, all seedlings survived the winter. Frost damage to the branch tips occurred in 7 %, 64 %, 25 % and 17 % of shrubs during the first four winters. The fourth winter, one shrub suffered frost damage to the previous year's wood and another, to the old wood.

At Deschambault, one plant died during each of the last three winters. Frost damage to the branch tips occurred in 40 %, 60 %, 92 %, 91 % and 30 % of plants during the five years. The second winter, 40 % of the roses had frost damage to the previous year's shoots and, the last winter, 60 % suffered damage from the weight of the snow.

At La Pocatière, one seedling died the first winter. Frost damage to the branch tips was observed in 93 %, 100 % and 25 % of plants the first two winters and the last winter. The aerial portion of the canes above the snow cover was affected in all shrubs the third winter.

Region 3

At Normandin, one plant died the second winter. Frost damage to the aerial portion above the snow cover was observed in 50 %, 92 %, 100 % and 100 % of shrubs during the first four winters. The first winter, 50 % of seedlings froze down to the ground level and, the last winter, frost damage to the branch tips occurred in 45 % of the plants and one rose was damaged by the weight of the snow.

At Kapuskasing, 13 %, 8 %, 10 % and 22 % of shrubs died during the first three winters and the last winter. Frost damage to the entire aerial portion of the plant occurred in 60 %, 8 %, 10 %, 56 % and 22 % of shrubs during the five winters. Similarly, frost damage to the one-year-old shoots occurred in 20 %, 8 %, 80 %, 44 % and 56 % of shrubs during the five winters. In addition, 62 % of plants suffered frost damage to the branch tips the second winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

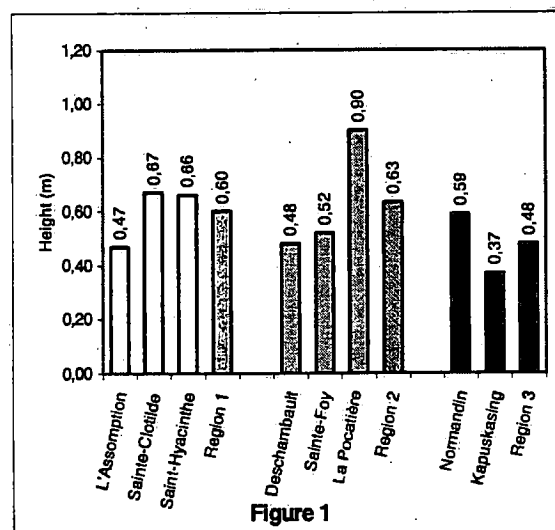


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

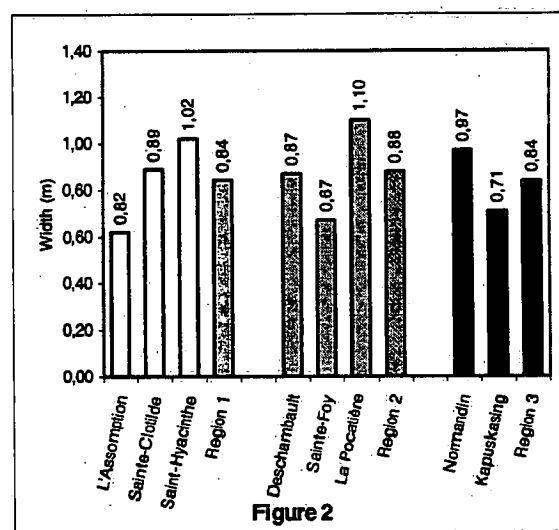


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Annual growth was irregular at all the sites, except La Pocatière, where it increased each year. The shrubs were all wider than they were tall by the first growing season.

Effect of pruning

Severe pruning was required to deal with the significant frost damage.

Flowering

Flowering occurred every year at L'Assomption and Saint-Hyacinthe, but for only two out of four years at Sainte-Clotilde. In the Montreal region, flowering began between June 6 and 20, lasting 86-135 days. In region 2, the first flowers appeared later, generally between June 22 and 25, and flowering lasted for 32-106 days depending on the year. In region 3, a few plants at Normandin flowered two out of the five years and all plants flowered at Kapuskasing. Flowering began June 26-July 5 and lasted 72-102 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After two growing seasons, 75-100 % of plants at all sites, except Kapuskasing, had reached a height of 25-50 cm. During the same period, all shrubs at Saint-Hyacinthe, Deschambault, Sainte-Foy and La Pocatière reached a width of over 51 cm.

Despite the fact that extensive winter damage to the aerial portion of the cultivar occurred, after being cut back severely, it achieved excellent annual growth and flowered abundantly. The cultivar can be produced in regions 1 and 2 as long as it receives adequate winter protection.

HARDINESS EVALUATION

Tests by the hybridizer (Ms. Svejda) in the Ottawa region and L'Assomption showed that this Explorer™ Series cultivar is hardy to zone 3.

The gradual mortality in zone 2a observed over five years in this trial confirms that the cultivar is truly at the limit of its cold tolerance in this zone.

The fact that the base and root systems were able to withstand climatic conditions at the sites in zones 5b to 2b indicates that the cultivar can survive and be used as far as zone 2b. Flowering is a potential limiting factor for its use, however.

Among the 25 roses in the hardy shrub rose series, this cultivar is one of those that suffered the most winter damage to the aerial portions of the plant. Despite the extent of this damage, the rose does not require special protection aside from the snow cover, giving it a great advantage over bush roses (hybrid teas, *floribunda* and *grandiflora*).

This cultivar did not achieve its full ornamental potential at the sites tested.

BIBLIOGRAPHIC REFERENCES

3, 7, 15, 24, 61, 62, 64

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Table 1. Frequency of winter damage observed on *Rosa 'Louis Jolliet'* from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage.
		WINTER DAMAGE ^a									
	1	2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	0	73				7		3		17	100
Sainte-Clotilde	7	17		65	6					5	93
Saint-Hyacinthe	25	53			2			2		18	75
REGION 2											
Deschambault	12	63		8				5	12		88
Sainte-Foy	74	23		2	1						26
La Pocatière	35	44				20		1			65
REGION 3											
Normandin	9	9				68	10	2	2		91
Kapuskasing	4	12		42			32	10			96

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 9 occurred for this cultivar.

Table 2. Breakdown of Rosa 'Louis Joliet' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-025	90	25	0	0	0	42	-	-	0	-	53	5	0	0	-
026-050	10	70	58	75	67	58	-	-	25	-	42	26	25	17	-
051-075	0	5	42	25	25	0	-	-	42	-	0	63	42	58	-
076-100	0	0	0	0	8	0	-	-	33	-	5	6	25	17	-
101-125	-	-	-	-	-	-	-	-	-	-	0	0	0	8	-
126-150	-	-	-	-	-	-	-	-	-	-	0	0	8	0	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-025	70	5	0	0	10	79	29	0	8	0	75	0	0	0	0
026-050	30	75	67	73	60	21	57	75	42	50	19	50	8	0	0
051-075	0	20	33	27	20	0	14	25	50	50	6	50	67	75	8
076-100	0	0	0	0	10	-	-	-	-	-	0	0	25	25	67
101-125	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17
126-150	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-025	83	9	0	0	0	100	77	44	22	44					
026-050	17	91	89	45	45	0	23	56	78	56					
051-075	0	0	11	44	44	-	-	-	-	-					
076-100	0	0	0	11	11	-	-	-	-	-					
101-125	-	-	-	-	-	-	-	-	-	-					
126-150	-	-	-	-	-	-	-	-	-	-					

*Data were collected two years at Sainte-Clotilde and four years at Saint Hyacinthe.

Table 3. Breakdown of Rosa 'Louis Jolliet' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	45	35	33	42	33	82	-	-	23	-	84	0	0	0	-
051-100	50	60	67	58	67	18	-	-	52	-	16	43	50	42	-
101-150	5	5	0	0	0	0	-	-	25	-	0	47	50	58	-
151-200	-	-	-	-	-	-	-	-	-	-	0	10	0	0	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	30	0	8	0	20	29	0	0	0	0	62	0	0	0	0
051-100	70	85	92	100	50	71	79	75	83	100	38	64	25	17	8
101-150	0	15	0	0	30	0	21	25	17	0	0	36	75	83	92
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	66	55	33	0	0	100	69	44	33	44					
051-100	34	45	67	55	66	0	31	45	67	44					
101-150	0	0	0	45	34	0	0	11	0	12					
151-200	-	-	-	-	-	-	-	-	-	-					

*Dats were collected two years at Sainte-Clotilde and four years at Saint Hyacinthe.

ROSA PIMPINELLIFOLIA

VAR. *FRÜHLINGSDUFT*

Family:	Rosaceae
English name:	Scotch Rose
French name:	Rosier épineux
Synonym:	<i>Rosa spinosissima</i> var. <i>Frühlingsduft</i>
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub, of dense, globular habit, may grow to 3 m tall and 1.8 m wide. It is more vigorous than the species form. The strong arching canes are covered with many fine thorns. The bark is dark brown.

The foliage is fine textured, turning from shiny dark green to reddish in fall. The singly serrate, ovate leaflets are smaller and finer than in other varieties.

The semi-double flowers (according to some authors, fully double) resemble those of hybrid tea roses, with rolled petals and a diameter of 7.5 cm. They are a lemon-creamy white flushed with pink, with deeper apricot tones in the centre. The variety flowers very abundantly in June, and is one of the earliest flowerers.

The round hips, deep purple to purplish black in colour, remain on the canes after the leaves have fallen.

This species is very prone to suckering when propagated from cuttings.

ORIGIN AND DISTRIBUTION

The species has been known since the 1600s and this variety was introduced on the market by Kordès in 1949. It is the result of a cross between 'Joanna Hill' (a hybrid tea) and *Rosa pimpinellifolia* 'Grandiflora' (synonym: *Rosa spinosissima* var. *altaica*). Widespread in Europe, Asia Minor and Central Asia, it occurs mainly near water.

USE

Ornamental: This shrub is common in Europe, where it grows near water, providing stability to dunes, and on calcareous heaths. It can be used for renaturalization purposes.

REQUIREMENTS

In general, roses need a sunny, airy spot; a minimum of 5-6 hours of sunshine per day is required to obtain vigorous plants that flower well. The ideal site will have early morning sun that burns off the dew (dew on the foliage can promote foliar diseases).

This rose is adapted to different soils. It prefers soil rich in organic matter but will also grow well in clay or even sandy soil enriched with organic matter. Good drainage is essential, since this rose does not tolerate an accumulation of water around its roots. The ideal soil pH is slightly acid (around 6.5), which promotes the proper balance of soil minerals.

Training is required during the first few years after planting. To ensure recurrent and abundant flowering, roses must be deadheaded. Pruning should also be done in spring to remove dead or damaged wood.

DISEASES AND INSECTS

Information on the main pests and diseases affecting this rose can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume II, Appendix I, Pathology and Insects on Roses, pages 391-2 (VR 221).

This variety is highly resistant to black spot and powdery mildew. However, several plants at Sainte-Clotilde and Deschambault had defoliation from black spot.

PROPAGATION

The cultivar can be propagated from cuttings or grafts.

Cuttings: Softwood cuttings are generally used in conjunction with a hormone rooting powder with 2,500-

6,000-ppm IBA. Dipping the base of the cutting for 5 seconds in a 4,000-ppm IBA solution is also done.

Rose cuttings are very susceptible to rot and special care must be taken to ensure the cleanliness of tools and work tables and to use sterile containers and substrate. A fungicide may be required when a mist unit is used.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: 280 cuttings (20 cm) were taken on July 4, 1990 and 40 others on July 27, from two-year-old parent plants measuring 70 cm high and 60 cm wide. The cuttings were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution. They were planted in plug trays filled with a Promix®-perlite mixture (1:1; v:v) and then placed under a mist unit operating for 30 seconds every 7 minutes. The rooting rate was 30 % as of August 7. The cuttings were overwintered in beds under glass cold frames. On May 3, 1991, they were wrapped and shipped.

Inclusion in testing network: Seedlings 10-15 cm high and 6-7 cm wide were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Several seedlings died at each site; mortality was greater in the coldest regions.

Region 1

At L'Assomption, all plants suffered frost damage to the aerial portions above the snow cover during four out of the five winters. In addition, a single plant died during each of the first and fourth winters. Frost damage to the branch tips was observed after the fourth winter.

At Sainte-Clotilde, several types of damage occurred, particularly the second and third winters. The second winter, 29 % of roses suffered frost damage to the branch tips, 21 % had damage to the floral buds and 50 % had damage to the previous year's shoots. The third winter, 64 % of roses had damage to the old wood, while the rest had damage to the shoots above the snow cover. The last two winters, light damage occurred in 64 % and 37 % of the roses.

At Saint-Hyacinthe, a single plant died during each of the first and fourth winters. Very little or no damage occurred the last few winters. However, during the first winter, 31 % of roses suffered frost damage to the shoots above the snow cover. Subsequently, the only damage that occurred was to the branch tips, in various degrees.

Region 2

At Deschambault, one seedling died the first winter. During the first four years, damage comprised frost injury to the previous year's shoots and branch tips. The last winter, 90 % of plants suffered frost damage to the aerial portion above ground level but one rose suffered no damage. One seedling suffered frost damage down to the ground level the second winter.

At Sainte-Foy, one plant died the third winter. The first and last winters, 30 % of plants suffered no damage, while the rest had only light damage, as they did in the fourth winter. As did many other species, 31 % of roses evaluated in the winter of 1992-93 had frost damage to the previous year's shoots. Close to 40 % of roses had frost damage to the aerial portion above the snow cover the second and third winters.

At La Pocatière, during the second and third winters, frost damage occurred mainly to the shoots above the snow cover. Close to 30 % of the seedlings had frost damage to the branch tips during the first two winters.

Region 3

At Normandin, 20 %, 33 % and 17 % of seedlings died the first, third and fourth winters respectively. The first winter, 80 % of seedlings had frost damage to the previous year's shoots. Between 60 % and 100 % of shrubs had damage to the entire aerial portion above the snow cover during the last four winters.

At Kapuskasing, 25 %, 17 % and 20 % of seedlings died the first, third and fourth winters. The first two winters, frost damage to the branch tips was observed in 38 % and 50 % of seedlings. Frost damage to the previous year's shoots occurred in all the other seedlings every winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

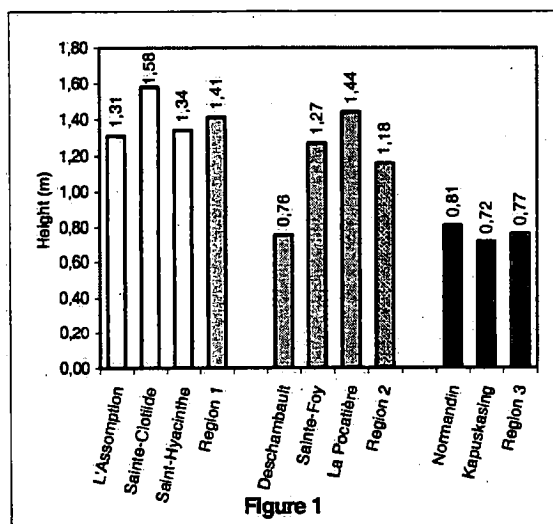


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

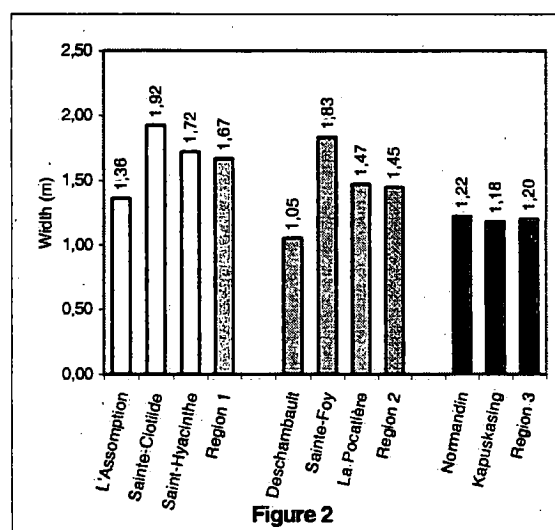


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Annual growth was significant, resulting in an increase in the final height of the plants every year at all sites, except Deschambault, Normandin and Kapuskasing. At Normandin, the maximum height was reached at the end of the third year, while at Deschambault and Normandin, little height growth was observed during the last three years.

Effect of pruning

Extensive pruning was required at all sites except Sainte-Clotilde; in general, 30-70 % of the previous year's growth had to be removed.

Flowering

Several plants flowered every year, but winter conditions affected the results.

Flowering began between June 15 and June 20 every year in region 1, 6-7 days later in region 2 and an additional two weeks later in region 3.

The duration of flowering was similar at all sites : 13-20 days, depending on the year and site. However, at Kapuskasing, flowering only occurred once on a single plant.

PRODUCTION RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants obtained at each test site after each year by height categories (heights are those obtained at the end of each year). Nursery operators will find this table useful for estimating annual production and the number of years needed to obtain a given height.

The seedlings were wider than they were tall by trial's end at all sites. Producing this rose has few advantages in terms of floral quality and resistance to climatic conditions, since a number of other rose species and cultivars are superior.

HARDINESS EVALUATION

This species is considered hardy as far as zone 4b. The many plants that died at the zone 2 sites during the trial shows that survival of the variety is problematic in this zone. In addition, at all the other sites, significant frost damage occurred.

Survival is a sure thing in zone 4a given adequate snow cover, and most likely, the same is true in zone 3. The variety can be used in zones 4 and 5, but its full ornamental potential can only be achieved in warmer areas than Quebec.

BIBLIOGRAPHIC REFERENCES

2, 5, 7, 8, 9, 34, 36, 39, 64, 72

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Table 1. Frequency of winter damage observed on *Rosa pimpinellifolia* var. *Frühlingsduft* from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	10	11	3	
REGION 1											
L'Assomption	0	16			80		4				100
Sainte-Clotilde	40	26	10	13	7					4	60
Saint-Hyacinthe	38	52			7		3				62
REGION 2											
Deschambault	2	29	49		18	1	1				98
Sainte-Foy	12	65	6		15		2				88
La Pocatière	52	12			34			2			48
REGION 3											
Normandin	0		16		70		14				100
Kapuskasing	2	18	64			4	12				98

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 9 and 11 occurred for this variety.

Table 2. Breakdown of *Rosa pimpinellifolia* var. *Frühlingsduft* plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	88	8	0	10	0	14	28	0	0	0	-	0	0	0	0
051-100	12	92	80	60	22	86	72	9	0	9	-	25	8	43	9
101-150	0	0	20	30	44	0	0	82	54	18	-	62	50	57	64
151-200	0	0	0	0	34	0	0	9	46	73	-	13	42	0	27
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	86	36	27	9	0	93	31	0	0	0	19	13	0	0	0
051-100	14	64	73	91	90	7	69	36	80	30	81	87	42	8	0
101-150	0	0	0	0	10	0	0	54	20	40	0	0	58	67	83
151-200	-	-	-	-	-	0	0	10	0	30	0	0	0	25	17
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	18	44	0	0	0	50	100	17	20	20					
051-100	82	56	44	100	100	50	0	83	80	80					
101-150	0	0	56	0	0	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

ROSA RUGOSA

'L'ASSOMPTION'

Family:	Rosaceae
English name:	L'Assomption Rough Rosa
French name:	Rosier rugueux 'L'Assomption'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub, of erect habit and with thorny canes, can grow to over 2.0 m tall and 1.5 m wide. The young shoots are pale green tinged with orangish-yellow, while the bark of the mature canes is dark reddish brown. This coloration is more pronounced than in the cultivar 'Martin Frobisher'. The ends of the canes are thornless. Growth is less vigorous than in the species form, but is equivalent to that in 'Martin Frobisher'.

The very fragrant semi-double flowers (roughly 15 petals) bloom abundantly beginning in late June, persisting until the first frosts. The floral buds are medium pink and the colour fades to a pale pink as the flower matures. The flowers are larger than those of 'Martin Frobisher' but the same size as the species form.

In general, the foliage is similar to that of the species form, but paler in colour. The leaflets are smaller than those in the species form.

This selection produces abundant hips, which turn orangish-red in fall.

ORIGIN AND DISTRIBUTION

This Canadian selection (F95) was developed in the late 1960s by Dr. Felicitas Svejda at the Ottawa Experimental Farm. *Rosa* 'L'Assomption' resulted from open pollination of the cultivar 'Martin Frobisher', which in turn is the product of open pollination of the European rose 'Schneezwerg'. Its parentage 'Martin Frobisher' and

'Schneezwerg' gives it a number of rugosa rose characters, as well as good floral quality. This new rose will be licensed and introduced shortly and propagated under authorized licences.

USE

Ornamental: This hybrid can be used as a specimen plant, in mass plantings or in a hedge at least 1.5 m high. The flowers are of particular interest, lasting from mid-June to the first frosts. To maintain the plant's ornamental characteristics and encourage recurrent blooming, the faded, dried petals and the hips should be removed.

Edibility: The hips, very rich in vitamin C, can be used in jams and jellies.

Value to birds: In fall, the ripe hips may attract some species of birds.

REQUIREMENTS

In general, roses need a sunny, airy spot; a minimum of 5-6 hours of sunshine per day is required to obtain vigorous plants that flower well. The ideal site will have early morning sun that burns off the dew (dew on the foliage can promote foliar diseases).

This rose is adapted to different soils. It prefers soil rich in organic matter but will also grow well in clay or even sandy soil enriched with organic matter. Good drainage is essential, since this rose does not tolerate an accumulation of water around its roots. The ideal soil pH is slightly acid (around 6.5), which promotes the uptake of soil minerals.

Training is required during the first few years after planting. To ensure recurrent and abundant flowering, roses must be deadheaded. Portions damaged by the cold or other factors must be cut back in spring.

DISEASES AND INSECTS

Rosa 'L'Assomption' is somewhat susceptible to black spot. This phenomenon was mainly observed at sites in warm,

humid regions (L'Assomption, Sainte-Clotilde, Deschambault and Saint-Hyacinthe), where partial defoliation and leaf spots were noted, depending on the year. This shows that 'L'Assomption' is more susceptible to cryptogamic diseases than the species form.

PROPAGATION

Cuttings: Cuttings are taken in March or April from greenhouse-forced plants or in June or July from field-grown parent plants. A hormone treatment will facilitate root formation. The date the cuttings were taken and length of the cuttings may affect the speed of rooting. The rooting rate is very high and cuttings survive the first winter very well.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, Ottawa (Ontario)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: Cuttings were taken when lignification was optimal, during flowering. On June 26, 1989, 353 cuttings (10 cm) were taken from roughly ten-year-old parent plants. The cuttings were dipped for 5 seconds in a 4,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. After being immersed in a fungicide solution (Benomyl-Captan®), they were planted in a peat-perlite mixture (2:3; v:v) and placed under a mist unit (Mist-A-Matic®). The rooting rate was 97 % after 41 days. On August 7, the seedlings were potted up in a peat-perlite mixture (3:2; v:v) and treated weekly with a soluble fertilizer (20-20-20) until mid-September. They were kept in an unheated greenhouse until mid-November, when they were put in the cold store at 0 °C in plastic bags perforated with a hatpin. In May 1990, 310 seedlings were transplanted to the nursery where they were grown on until May 1991. They were then dug up, puddled, wrapped and put in the cold store at 4 °C to await shipping.

Inclusion in testing network: Seedlings 20-30 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At the L'Assomption site, all the plants had frost damage to the branch tips during the first four winters. The fifth winter, 33 % of the roses had no damage, 33 % had frost damage to the branch tips and 33 % had much more severe damage, affecting the entire aerial portion of the plant above the snow cover.

At Sainte-Clotilde, no damage was found after the first winter but, the next two winters, 67 % of roses had frost damage to the branch tips. Damage intensified in subsequent years: 50 % of roses had frost damage to the branch tips, 33 % had damage to the previous year's shoots and 17 % died. The last winter, all the remaining plants died.

At Saint-Hyacinthe, close to 60 % of the roses had frost damage to the branch tips during the first two winters and 25 % had the same type of damage the third winter. No other damage occurred during the trial.

Region 2

At Sainte-Foy, 50 % of the shrubs had frost damage to the branch tips during the first two winters, and 75 % and 34 % the third and fourth winters respectively. In addition, 25 % of the roses had frost damage to the previous year's shoots the third winter. Severe leaf drop was also observed

following a drought. No damage was observed the last year.

At La Pocatière, no damage occurred the first winter and the last two winters. The other two winters, most of the roses suffered frost damage to the branch tips. The third winter, close to 33 % of plants had frost damage to the previous year's shoots.

At Deschambault, winter damage was limited to the branch tips in 19 % and 43 % of roses during the first two winters. In subsequent winters, damage was more widespread and severe: the third and fourth winters, 75 % and 83 % of shrubs had damage to the previous year's shoots and 17 % and 40 % of roses died the fourth and fifth winters. The last year, damage to the previous year's shoots (10 %) and old wood (10 %), as well as mechanical breakage (10 %), occurred.

Region 3

At Normandin, no damage was observed during the first and last winters. The second winter, all roses suffered frost damage to the branch tips and, in the third winter, to the aerial portion of the canes above the snow cover. Subsequently, mechanical breakage caused by the weight of the snow and ice occurred in 67 % of the shrubs.

At Kapuskasing, 18 %, 21 % and 37 % of plants died the first three winters and 21 % died the last winter. In addition, in the second winter, 14 % of roses suffered frost damage down to the ground level. The third winter, 63 % suffered damage to the previous year's shoots and the same proportion suffered damage to the branch tips each of the five winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

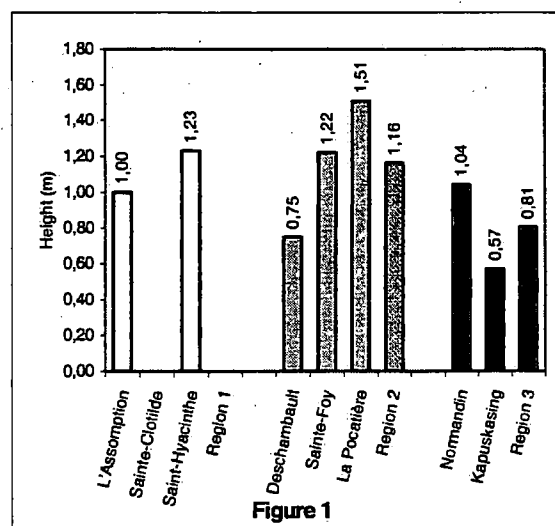


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

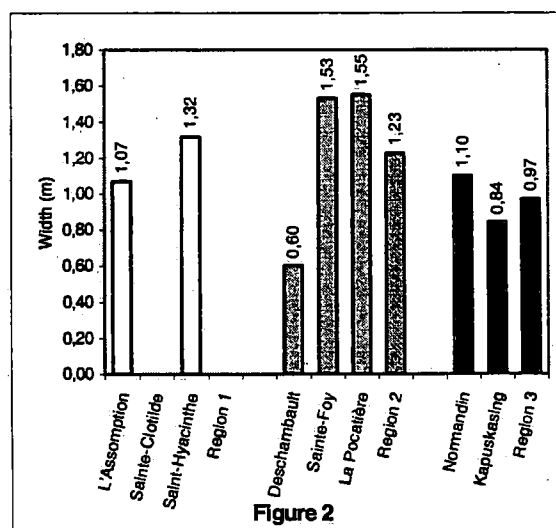


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth was less vigorous in the cultivar than in the species form but was equivalent to that in 'Martin Frobisher'.

There was a great deal of variability in the results for sites in region 2 and region 3.

At La Pocatière and L'Assomption, height growth at the end of the growing season increased annually over the five years of the trials, while at Saint-Hyacinthe, there was a

significant spurt in height growth at the end of the second growing season.

Effect of pruning

Pruning is not really required for this rose, since winter damage is slight and growth is very uniform from year to year. Training is required when the rose is first planted, however.

Flowering

Flowering occurred every year on all shrubs at every site, regardless of the conditions the previous winter.

In region 1, flowering began around June 15 every year, while in region 2, the first flowers appeared 8-10 days later. In region 3, the first flowering date was highly variable, ranging from July 4 to July 24 depending on the year.

The duration of flowering ranged from 80 to 125 days at L'Assomption, Saint-Hyacinthe and Sainte-Foy. It was around 30 days at Sainte-Clotilde, which reflects the first flowering date. At the other sites, flowering lasted 50-70 days on average. The petals of the old flowers remained on the plants at La Pocatière and Normandin.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Vigorous growth occurred at sites in hardiness zone 4 with a plentiful snow cover and at sites in the Montreal region. At some sites like La Pocatière, the roses grew very tall and very wide, with almost no disease or winter damage. The best growth was achieved in areas with a long fall and frequent snowfalls.

At the other region 2 sites (Sainte-Foy and Deschambault), results were highly variable. The roses were wider than they were tall at Sainte-Foy, while at Deschambault, the rose's real potential could not be determined due to insect attacks.

At the sites in the warmest zone, growth was best at Saint-Hyacinthe, while the plants at L'Assomption and Sainte-Clotilde were smaller at trial's end. However, the climatic conditions that slowed growth at the last two sites also resulted in a more ornamental appearance in the roses.

HARDINESS EVALUATION

This rose is quite hardy and performs well in zones 2b to 5, albeit with frost damage to the branch tips. Growth was good in all regions and flowering lasted for several weeks.

This rose is very similar to the Explorer rose 'Martin Frobisher' and there are not enough botanical differences to put it in its own series. It is a good product, well adapted to different soil types and climatic conditions. It is easy to propagate from cuttings and grows quickly. It is long flowering and the blossoms are a beautiful pink colour.

BIBLIOGRAPHIC REFERENCES

2, 68

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Table 1. Frequency of winter damage observed on *Rosa rugosa* 'L'Assomption' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	18	34		7		39		2				82
Sainte-Clotilde	14	50						36				86
Saint-Hyacinthe	60	40										40
REGION 2												
Deschambault	15	32		38	2			11		2		85
Sainte-Foy	59	38		3								41
La Pocatière	56	34		10								44
REGION 3												
Normandin	47	20				20				13		53
Kapuskasing	19	49		14			3	15				81

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Rosa rugosa* 'L'Assomption' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	90	0	0	0	0	85	5	8	0	0	-	0	0	0	0
051-100	10	100	100	33	55	15	95	50	42	50	-	62	58	50	8
101-150	0	0	0	67	45	0	0	42	58	50	-	38	42	50	84
151-200	-	-	-	-	-	-	-	-	-	-	-	0	0	0	8
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	0	0	0	0	76	0	0	0	0	86	0	0	0	0
051-100	0	100	58	83	100	24	100	58	17	8	14	100	50	0	0
101-150	0	0	42	17	0	0	0	42	83	92	0	0	50	58	8
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	42	92
REGION 3															
Height (cm)	Normandin					Kapusksing									
	91	92	93	94	95	91	92	93	94	95					
001-050	62	24	0	0	8	100	93	62	75	25					
051-100	38	76	25	75	25	0	7	38	25	75					
101-150	0	0	75	25	67	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Rosa rugosa* 'L'Assomption' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	90	15	0	0	0	76	24	0	0	0	-	0	0	0	0
051-100	10	85	67	25	18	24	71	17	42	50	-	81	33	16	8
101-150	0	0	33	75	82	0	5	58	50	50	-	19	67	76	84
151-200	-	-	-	-	-	0	0	25	8	0	-	0	0	8	8
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	52	0	0	0	20	9	0	0	0	0	42	0	0	0	0
051-100	48	34	17	50	80	91	9	17	0	0	58	100	33	0	0
101-150	0	66	83	50	0	0	91	83	100	42	0	0	67	83	50
151-200	-	-	-	-	-	0	0	0	0	58	-	0	0	17	50
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	57	0	0	0	8	100	100	50	13	0					
051-100	43	33	42	8	8	0	0	50	87	100					
101-150	0	67	58	92	84	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

SPIRAEA JAPONICA

'SHIROBANA'

Family:	Rosaceae
English name:	Shirobana Spirea
French name:	Spirée 'Shirobana'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This low, mound-shaped compact shrub grows to 0.8 m high and wide.

The twigs are slightly pubescent, but become glabrous with age.

The buds are ovoid, and slightly acuminate. The simple deciduous leaves, oval to oblong in shape, are light green in colour. They are short-petioled and pubescent on the veins.

Flowering occurs in midsummer. The flowers, 4 mm across, are grouped in flat corymbs and may be pink, white or both colours.

The plant's many fine roots ensure rapid growth.

ORIGIN AND DISTRIBUTION

The species is native to Japan and has been cultivated since 1870.

USE

Ornamental: This cultivar, prized for its flowers, is used alone or in mass plantings.

REQUIREMENTS

For continuous flowering, full sun is required. The cultivar tolerates a wide range of soil types but prefers moist, fertile soils. Pruning should be done in early spring or

immediately after flowering, to promote a new crop of flowers.

DISEASES AND INSECTS

The spirea aphid (*Aphis spiraeicola*) appears around late June or early July. Green in colour, it infests the young shoots and inflorescences. Spittlebugs are the only insects to cause serious damage to spireas.

The main disease found is mildew, which appears as light brown spots on the upper surface of the leaves. Spireas may also be attacked by fireblight and septoria leaf spot.

Nematodes also attack spireas.

PROPAGATION

Cuttings: Woody cuttings taken in winter and softwood or semi-ripe cuttings taken in summer give good results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Dominique Savio, Saint-Hilaire (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 360 cuttings (5 cm) were taken on March 12, 1991, from three-year-old parent plants measuring roughly 40 cm tall and 35 cm wide, forced in the greenhouse. The cuttings were dipped in a 5,000-ppm IBA/50 % ethanol solution for 5 seconds. They were then planted in plug trays filled with Promix® and perlite (1:2; v:v) and placed under a mist unit set with 45 seconds misting every 10 minutes. The heating cables were set at 25 °C. Weekly fungicide treatments with Benomyl® were provided throughout the propagation period. The rooting rate was 95 % after 4 weeks. The plants were placed in a lathhouse and fertilized with a 10-52-10 solution at the recommended rate. On May 23, the seedlings were transplanted to the nursery, where a 20-20-20 soluble fertilizer was applied at the recommended rate. On

October 15, they were dug up, puddled and heeled in for the winter. In April 1992, they were wrapped and stored in a cellar to await shipping in May.

Inclusion in testing network: Seedlings 9 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the variety over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died the first winter. Most of the seedlings suffered frost damage to the aerial portion above the snow cover. The first two winters, 63 % and 66 % of plants suffered frost damage to the branch tips and 25 % suffered rodent damage the last winter.

Almost all the seedlings at Sainte-Clotilde suffered frost damage to the one-year-old shoots. The first winter, 80 % of seedlings had frost damage to the branch tips.

At Saint-Hyacinthe, 50 % of seedlings died shortly after being transplanted and only three plants survived for all five years of the tests. The last four years, frost damage to the branch tips occurred in 60 %, 60 %, 100 % and 30 % of shrubs. The second winter, 40 % of plants had frost damage to the entire aerial portion above the snow cover.

Region 2

At Sainte-Foy, two seedlings suffered frost damage to the branch tips the first winter. No subsequent damage occurred.

At Deschambault, most of the seedlings had frost damage to the one-year-old shoots. The first, third and fourth

winters, 57 %, 75 % and 17 % of the shrubs had frost damage to the branch tips. Almost all shrubs suffered mechanical breakage the last winter due to climatic conditions.

At La Pocatière, close to 50 % of seedlings suffered damage to the one-year-old shoots and one seedling had frost damage to the entire aerial portion. The other winters, all the shrubs had frost damage to the branch tips.

Region 3

At Normandin, one plant died the third winter and two others the next winter. Frost damage to the aerial portion above the ground level occurred in 30 % of seedlings the first winter. The last winter, 56 % of shrubs suffered mechanical breakage due to the climatic conditions.

Eight plants died at Kapuskasing, seven during the first two winters. The main damage was frost injury to the aerial portions of the plants. The one-year-old shoots were affected in 6 %, 40 %, 60 % and 78 % of shrubs the last four winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

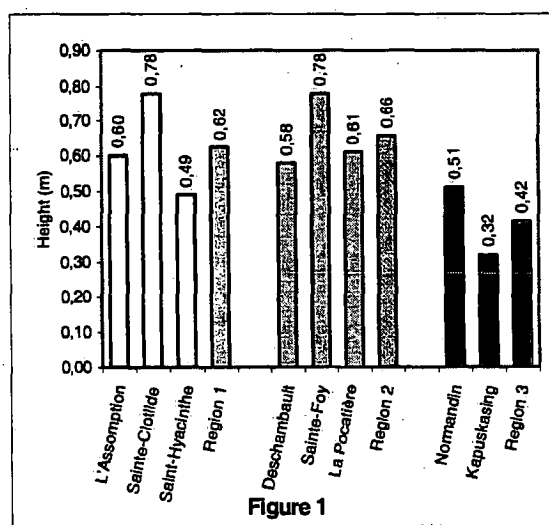


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

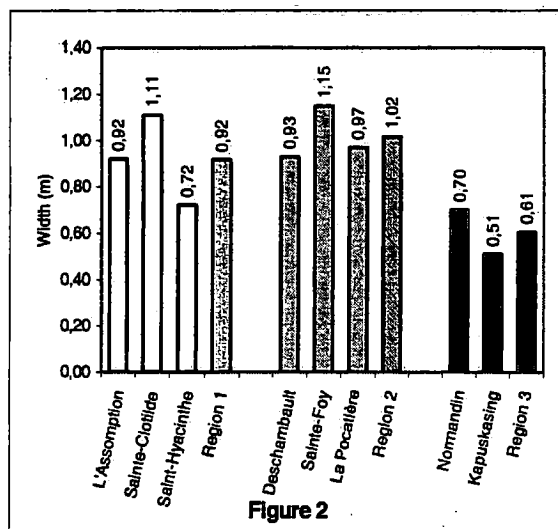


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

Very light pruning was done on the seedlings at Sainte-Clotilde, Sainte-Foy and La Pocatière, while extensive pruning had to be done at all the other sites.

Flowering

Flowering occurred every year at all sites, except Normandin, where it was less regular. At L'Assomption, flowering began between June 30 and July 10 and ended in October, 94-112 days later. At Saint-Hyacinthe, it began between June 13 and July 5 and lasted 29-59 days. In region 2, it began the second week of June (June 7-11), and a few days later at La Pocatière and Normandin. Duration of flowering was 90-98 days at Sainte-Foy and Deschambault and 31-40 days at La Pocatière. At Kapuskasing, flowering began between mid-July and late August, lasting 31-41 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will

find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

At region 1 and 2 sites, this cultivar can reach over 51 cm tall after three growing seasons, while in region 3, plants did not attain a comparable height during the tests.

The cultivar can be produced in regions 1 and 2 with adequate winter protection.

HARDINESS EVALUATION

The species is considered hardy to USDA zone 5 (Rehder). Most of the seedlings at Kapuskasing died (zone 2a) and some adult plants succumbed at Normandin (zone 2b). In addition, a number of plants died at Saint-Hyacinthe (zone 5a), where the soil conditions are not favourable to the growth of this cultivar (overly heavy soils) and where the snow cover can disappear during the winter or may not accumulate early enough to guard against the autumn cold. The test results show that the cultivar can survive to zone 3 under favourable growing conditions.

The cultivar flowers mainly from the current year's shoots and can be used in zones 4 and 5, with the proviso that winter damage may significantly reduce flowering.

Full ornamental potential was achieved at Sainte-Foy.

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3, 7, 9, 21, 23, 37, 39, 41

WRITTEN BY

Claude Richer, Agr.

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Table 1. Frequency of winter damage observed on *Spiraea japonica* 'Shirobana' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	3	4	5	6	7	8	9	10	11	
REGION 1												
L'Assomption	0	26				68		1			5	100
Sainte-Clotilde	0	16		73	7			3			1	100
Saint-Hyacinthe	27	50		1		8		14				73
REGION 2												
Deschambault	13	26		43						18		87
Sainte-Foy	98	2										2
La Pocatière	46	42		9		2	1					54
REGION 3												
Normandin	76						6	6		12		24
Kapuskasing	0			37			54	9				100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 9 occurred for this cultivar.

Table 2. Breakdown of *Spiraea japonica* 'Shirobana' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	89	0	0	0	100	76	25	0	0	100	33	20	60	60
051-100	0	11	100	100	100	0	24	75	100	100	0	67	80	40	40
101-150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	67	25	0	25	100	74	0	0	0	100	41	8	8	25
051-100	0	33	75	67	75	0	26	100	100	100	0	59	92	92	75
101-150	0	0	0	16	0	-	-	-	-	-	-	-	-	-	-
151-200	0	0	0	17	0	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	100	82	33	55	100	100	100	100	89					
051-100	0	0	18	67	45	0	0	0	0	11					
101-150	-	-	-	-	-	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Spiraea japonica* 'Shirobana' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	100	67	0	0	8	100	41	0	0	0	100	33	0	10	0
051-100	0	33	100	92	50	0	59	100	55	27	0	67	100	90	100
101-150	0	0	0	8	42	0	0	0	45	73	-	-	-	-	-
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	90	5	0	0	0	100	16	0	0	0	100	41	8	0	8
051-100	10	95	100	58	83	0	84	100	8	25	0	59	92	58	58
101-150	0	0	0	8	17	0	0	0	92	75	0	0	0	42	34
151-200	0	0	0	26	0	-	-	-	-	-	-	-	-	-	-
201-250	0	0	0	8	0	-	-	-	-	-	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	100	65	64	11	11	100	100	70	70	56					
051-100	0	35	36	89	78	0	0	30	30	44					
101-150	0	0	0	0	11	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

SPIRAEA TRICHOCARPA

'SNOW WHITE'

Family:	Rosaceae
English name:	Snow White Spirea
French name:	Spirée 'Snow White'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This upright bush may reach a height of 1.25 m and a width of 1.50 m.

The angular, glabrous, graceful stems bend as they age. They have oblong or lanceolate leaves, pointed, smooth and slightly dentate.

The large white flowers are clustered in corymbs. This is one of the last spireas to bloom in the spring.

The roots are fine and fibrous and lie close to the surface.

ORIGIN AND DISTRIBUTION

The species comes from Korea and the cultivar has been found throughout Canada for more than 30 years. It has been used on the Prairies, where it grows better than its relative *Spiraea x vanhouttei* (Briot) Zabel.

USE

Ornamental: This bush may be used by itself or as part of a grouping.

REQUIREMENTS

This spirea needs a sunny spot. It prefers fertile soil but can survive in poor. It grows better in a humid atmosphere but will tolerate drought.

When grown in a pot, this plant recovers easily after transplantation.

Pruning is done after the plant has flowered. Almost all spireas need to be cut back, and recover very well even when they are cut nearly level with the ground.

DISEASE AND INSECTS

In general, few pathogens or insects affect spireas.

PROPAGATION

Cuttings: Softwood cuttings are a proven technique, and the use of a hormone powder with an IBA concentration between 2,500 and 6,000 ppm is recommended. Quick soaking of the base of the cutting is also done 5 seconds in a hormone solution of IBA at 4,000 ppm.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Fruticetum, Montreal Botanical Garden, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: Two hundred 15-cm cuttings were taken on July 24, 1990 from 4-year-old parent plants 70 cm tall and 60 cm wide. They were soaked for 5 seconds in a solution of 4,000 ppm IBA and 50 % ethanol. They were placed in multipots filled with a medium of Promix® and perlite (1:1; v:v), then misted for 30 seconds every 7 minutes. The rooting rate was 87 % after 4 weeks. The cuttings were placed in beds where they overwintered protected by coldframes and panels. The survival rate was 100 %. On May 1, 1991, the seedlings were wrapped in plastic bags and placed in cold storage at 4 °C until shipment.

Inclusion in testing network: Seedlings 20 cm tall were planted at eight trial sites throughout Quebec and northeastern Ontario. Their over-winter survival and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

The frequency of winter damage observed over 5 years on this cultivar is presented in Table 1. Details of the main damage that occurred each winter at each of the sites are given below.

During the trial, there was seedling mortality at all sites, particularly Kapuskasing and Normandin, where all the seedlings died.

Region 1

In L'Assomption, all the seedlings were damaged during the trials every year. Between 80 % and 100 % of the seedlings had frost damage to their stem tips four winters out of five. The second winter, 93 % of the bushes had frost damage to the above-ground portion (above the snow cover) and 7 % of them died.

In Sainte-Clotilde, one seedling died the first winter and no other damage was observed during the first three winters. The fourth and fifth winters, 100 % and 33 % of the seedlings showed frost damage to stem tips.

In Saint-Hyacinthe, as at the above sites, one seedling died the first winter. The first three years, frost damage to stem tips occurred on 95 %, 25 % and 33 % of the bushes and damage to the above-ground portion (above the snow cover) occurred on 35 % of bushes the second winter.

Region 2

In Deschambault, damage became more severe over the years. During the five winters, 20 %, 20 %, 67 %, 67 % and 45 % of bushes suffered damage to stem tips. The third and fourth winters, 33 % and 25 % of the seedlings showed frost damage to the previous year's shoot. The last winter, 45 % of the seedlings had damage to old wood. One seedling died in each of the last two winters.

In Sainte-Foy, frost damage to stem tips was observed on 35 % and 100 % of bushes the second and fourth winters.

The second winter, 30 % of the seedlings had frost damage to the above-ground portion (above the snow cover) and 33 % had rodent damage the following winter.

In La Pocatière, frost damage was limited to frost on the stem tips on 95 % of the seedlings the first winter. The third and fourth winters, increasingly severe damage was observed, affecting the previous year's shoot on 42 % and 50 % of the seedlings. One seedling died the first winter and 33 % of the seedlings died the fourth winter.

Region 3

In Normandin, all seedlings died during the first four winters. The seedlings that survived all had slight damage.

In Kapuskasing, a similar scenario was played out over three winters. In addition, the surviving seedlings all showed frost damage right down to ground level.

Height and width growth

Figures 1 and 2 show the average height and width of seedlings after five years of trials at each site and region.

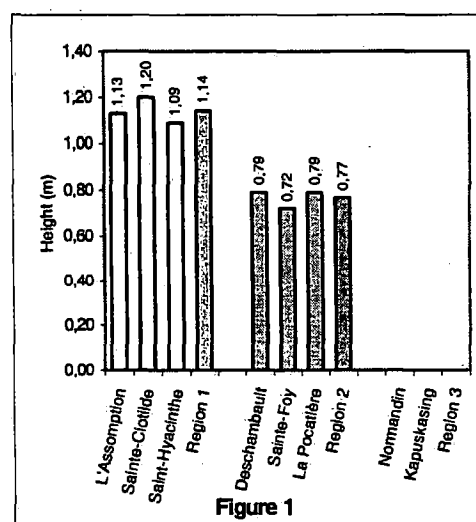


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

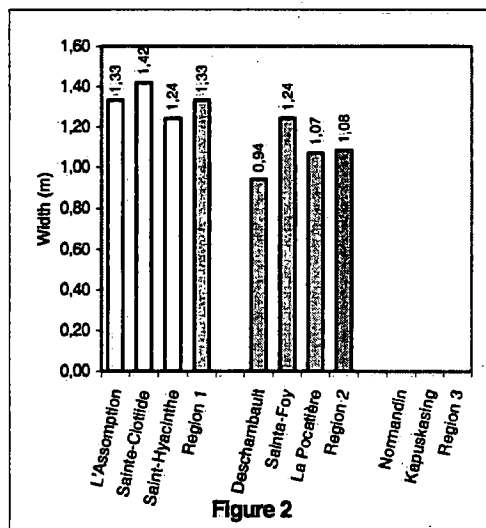


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

At the Sainte-Clotilde and L'Assomption sites, the final height at the end of the season increased every year, whereas in Saint-Hyacinthe no gain in height was observed by the end of the third year. At the other sites, the height reached its maximum value at the end of the fourth year of the trial.

Effect of pruning

Little pruning was done except at the Saint-Hyacinthe and Sainte-Foy sites, where seedlings were severely damaged by voles.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, and this, for the height and the width finales obtained each year. Nursery growers will find these tables useful for estimating annual production as well as the number of years needed to obtain a predetermined height and width.

Production of this spirea has few advantages, whether by the quality of its flowers or by its resistance to climatic conditions. A number of species and cultivars of spirea are superior. It grows very quickly, however, as after three

years of cultivation, the seedlings at almost all sites had reached a height of between 40 and 60 cm. However, in La Pocatière, an exceptional growth rate meant that several bushes of that height were obtained right from the end of the first season, while all of them had grown at least that tall by the end of the second season.

The growth in width is greater, and faster, for this upright bush.

HARDINESS EVALUATION

The die-off of all seedlings at sites in zone 2 confirms that this cultivar is not suited to zones that cold. The relatively high mortality in zone 4a indicates that this cultivar is at its limits here and that a good proportion of the seedlings will not survive there without the help of a protective layer of snow; its survival rating is therefore limited to zone 4b. In addition, its survival is threatened in zone 5a in a hard winter.

The seedling's potential for use may extend to zone 4b.

The seedling's full ornamental potential can only be achieved in warmer climatic zones than those of the trial.

BIBLIOGRAPHIC REFERENCES

2, 7, 9, 21, 26, 31, 33, 35, 67

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Table 1. Frequency of winter damage observed on *Spiraea trichocarpa* 'Snow White' from 1991 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	0	76				19		5			100
Sainte-Clotilde	73	26						1			27
Saint-Hyacinthe	61	31				7		1			39
REGION 2											
Deschambault	33	42		13	9			3			67
Sainte-Foy	58	29				6				7	42
La Pocatière	55	19		18				8			45
REGION 3											
Normandin*	0							100			100
Kapuskasing*	0							100			100

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*All plants were dead.

No damage of type 3, 7 and 10 occurred for this cultivar.

Table 2. Breakdown of *Spiraea trichocarpa* 'Snow White' plants by marketable height category from 1991 to 1995

TABLE 2: Breakdown of optimal play shown when playing against a 100% optimal opponent

REGION 1																
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*					
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95	
001-040	100	45	8	0	0	100	52	0	0	0	-	5	0	0	0	
041-080	0	46	92	0	8	0	48	67	0	0	-	69	8	8	8	
081-120	0	0	0	92	58	0	0	33	92	50	-	21	67	75	59	
121-160	0	0	0	8	34	0	0	0	8	50	-	5	25	17	33	
REGION 2																
Height (cm)	Deschambault					Sainte-Foy					La Pocatière					
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95	
001-040	100	48	8	8	0	100	75	8	8	0	43	10	0	0	12	
041-080	0	52	75	42	45	0	25	67	67	58	57	85	75	16	40	
081-120	0	0	17	50	55	0	0	25	25	42	0	5	25	84	25	
121-160	-	-	-	-	-	-	-	-	-	-	0	0	0	0	13	

*Dats were collected since 1992.

Table 3. Breakdown of *Spiraea trichocarpa* 'Snow White' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	95	7	0	0	0	95	10	0	0	0	-	0	0	0	0
041-080	5	93	17	0	8	5	63	17	0	0	-	36	0	0	0
081-120	0	0	83	58	0	0	27	59	25	0	-	58	50	33	42
121-160	0	0	0	42	92	0	0	16	67	87	-	6	50	67	58
161-240	-	-	-	-	-	0	0	8	8	13	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	12	0	0	0	0	50	0	0	0	0	5	0	0	0	0
041-080	88	6	8	8	45	50	0	8	25	0	90	10	0	0	25
081-120	0	88	25	68	27	0	70	42	50	42	5	90	58	33	38
121-160	0	6	67	24	28	0	30	50	25	50	0	0	42	50	37
161-240	-	-	-	-	-	0	0	0	0	8	0	0	0	17	0

*Datas were collected since 1992.

SYRINGA MEYERI

'PALIBIN'

Family:	Oleaceae
English name:	Palibin Lilac, Dwarf Korean Lilac
French name:	Lilas de mandchourie, lilas coréen
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This dwarf shrub of rounded, compact, regular habit can grow to over 1.2 m high and 1.5 m wide.

The short trunk bears numerous upright, spreading limbs with many secondary branches. It has greenish-grey bark.

The small, entire leaves range from oval to elliptic in shape, and are dull green above and greyish beneath. The foliage is light and graceful looking.

This cultivar flowers profusely. The lightly scented light lilac to pinkish lilac flowers appear in early summer and are arranged in small panicles. A second crop of flowers, fewer in number, is produced in August.

The fruits have no ornamental value.

The many shallow roots do not form suckers. This cultivar is easy to transplant.

ORIGIN AND DISTRIBUTION

The species comes from western China and was introduced in Europe around 1908. The cultivar has been grown in America since 1984.

USE

Ornamental: This cultivar, prized for its shape and flowers, is used in landscaping small areas, in rock gardens and in massed plantings. It appears to best advantage as a single specimen on a lawn or in a bed.

The cultivar can also be propagated by top grafting, using a shoot 1.0 m to 1.5 m long. This results in a taller plant (standard) with a greater range of uses.

REQUIREMENTS

Although lilacs grow happily in light shade, they flower best in full sun. This cultivar will grow in any type of soil but prefers fertile, well-drained, permeable and slightly calcareous soils. Although the shrub is hardy, during the first few years, scion-grafted plants tend to be fragile at the graft union.

Old blossoms should be removed as soon as they fade to promote the formation of the second crop of flowers. In older specimens, which tend to flower a second time anyway, deadheading is done for purely aesthetic reasons.

DISEASES AND INSECTS

This cultivar does not seem to be affected much by insects or diseases.

PROPAGATION

Cuttings: Semi-woody cuttings taken after flowering and treated with a hormone solution usually give good results.

Grafting: 'Palibin' is generally grafted onto a rootstock of the same species.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Meister ltée, Saint-Télesphore (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 460 cuttings 10-12 cm in length were taken on June 19, 1990 from four-year-old parent plants roughly 50 cm tall and 30 cm wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution and then planted in plug trays filled with sand and Promix® (1:1; v:v). They were placed under a

mist unit (Mist-A-Matic[®]). The rooting rate was 99 % after three weeks. The plants were treated with a liquid fertilizer (10-52-10). They were potted up on July 31 and fertilized a second time. They spent the winter in a bed, with a survival rate of 98 %. On April 18, 1991, they were wrapped in plastic bags and placed in the cold store to await shipping in may.

Inclusion in testing network: Seedlings 12 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 65 % of the seedlings died the first winter. Frost damage to the branch tips occurred in 5 %, 100 % and 67 % of plants during the first three winters. No damage was observed during the last two winters.

At Sainte-Clotilde, although one seedling died the first winter, no other damage occurred.

At Saint-Hyacinthe, 68 % of seedlings died the first winter and only one plant survived the fourth winter. Between this time, the only damage observed was frost damage to the branch tips in 32 % and 20 % of plants during the first two winters.

Region 2

At Sainte-Foy, one seedling died the third winter. The first winter, 14 % of plants suffered frost damage down to the ground. Frost damage to the branch tips occurred in 14 %, 100 %, 45 % and 100 % of plants during the first four winters. Damage to one-year-old shoots and old wood

occurred in 9 % and 36 % of shrubs during the third winter. No damaged occurred the last winter.

At Deschambault, plants died every winter, with 44 %, 10 %, 63 %, 33 % and 50 % of them dying over the five winters and only one plant still alive at the end of the tests. The only other damage was frost injury to the branch tips during the first three winters in 11 %, 30 % and 13 % of shrubs and frost damage to the current year's shoots in 11 %, 20 % and 25 % of shrubs during the same winters.

At La Pocatière, 15 %, 30 %, 43 % and 75 % of plants died respectively during the last four winters, leaving only one surviving shrub at the end of the tests. Other damage was limited to frost injury to the branch tips in 70 % and 50 % of plants during the second and third winters and frost damage to the previous year's shoots in 15 %, 10 % and 57 % of shrubs during the second, third and fourth winters.

Region 3

At Normandin, 24 %, 18 %, 22 % and 14 % of plants died the first winter and during the last three winters, leaving six plants alive at the end of the tests. No other damage occurred.

At Kapuskasing, all the seedlings died the first winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

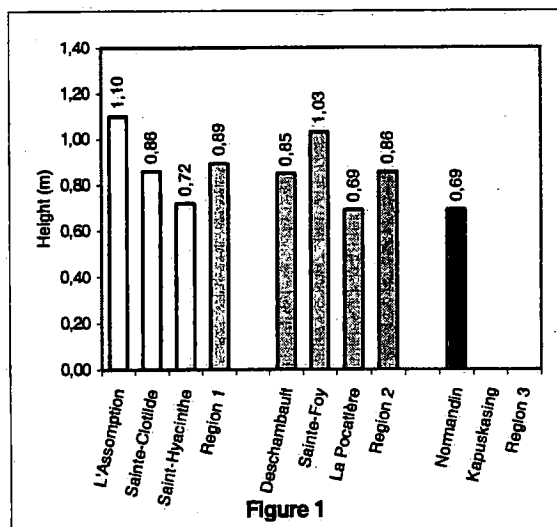


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

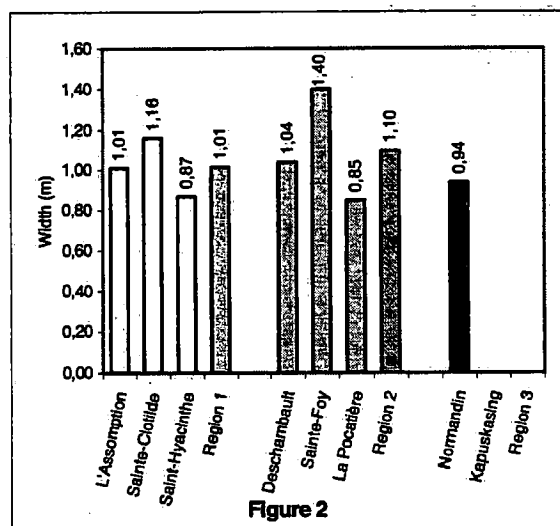


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Annual growth was constant from year to year at L'Assomption, but dropped beginning in the third year at Sainte-Clotilde, Deschambault, La Pocatière and Normandin. At Saint-Hyacinthe, annual growth decreased with time. At Sainte-Foy, strong growth occurred in the third and fourth years.

Width growth was particularly strong at Sainte-Foy.

Effect of pruning

In general, the only pruning needed was to remove injured portions of the plants.

Flowering

Plants flowered at all the sites, except Kapuskasing. In general, the flowering period ranged from 15 to 23 days. At Saint-Hyacinthe, the plants flowered again in August for two to three weeks every year of the test. Second flowering was more variable at the other sites.

In region 1, the first flowers were observed between May 15 and 25 on the south shore, depending on the year, and around June 9 on the north shore. The flowers had all faded by around June 25, regardless of when flowering began.

In region 2, the first flowers invariably appeared between June 10 and 16 at all three sites every year. The flowering period was a bit shorter at La Pocatière.

At Normandin, flowering lasted for 23 days each year (June 22-July 20).

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

This cultivar was not affected to any significant degree by insects or foliar diseases. Growth was steady, and after two years, all plants at L'Assomption and Saint-Hyacinthe were over 40 cm high; over 80 % of the plants at Sainte-Clotilde, Sainte-Foy, La Pocatière and even Normandin were of comparable height, since excessively weak plants had been eliminated the first year.

This cultivar can be produced in zones 4 and 5 as long as the root system is well protected against winter root kill.

HARDINESS EVALUATION

According to the literature, this cultivar's hardiness ranges from zone 5 to zone 2b. The test results indicate an extremely wide range in terms of winter damage. Responses either consisted of mortality or relatively light frost damage or even no damage at all. mortality seems to have been caused by the freezing of the root system in extremely cold weather (Normandin and Kapuskasing) or in the absence of adequate snow cover (Saint-Hyacinthe and La Pocatière). At La Pocatière, on the other hand, specimens were strongly affected by summer drought.

In zone 4, plants survived only at Sainte-Foy, which had an excellent snow cover, appearing early and remaining for the entire winter. Winter damage was more severe at this site, however, than in zone 5.

In zone 5, mortality occurred the first winter but little damage occurred subsequently at L'Assomption and Sainte-Clotilde.

The cultivar will survive as far as zone 5b without winter protection. However, it can be used as far north as zone 4 as long as the root system is adequately protected from the cold, particularly in the first years after planting. When the root system is well protected, the cultivar will display most of its ornamental characteristics.

The species achieves its full ornamental potential outside the hardiness zones tested.

BIBLIOGRAPHIC REFERENCES

2, 4, 7, 8, 9, 10, 18, 20, 21, 22, 26, 28, 29, 31, 33, 34, 36, 39, 67

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Syringa meyeri* 'Palibin' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	53	34					13				47
Sainte-Clotilde	99						1				1
Saint-Hyacinthe*	54	10					36				46
REGION 2											
Deschambault	28	11	11				40			10	72
Sainte-Foy	33	52	2	8		3	2				67
La Pocatière	22	24	16				33		5		78
REGION 3											
Normandin**	84						16				16
Kapuskasing	0						100				100

* Key:

1 = no damage

2 = damage to the tip of the previous year's shoot

3 = frost damage on the flower buds

4 = previous year's shoot affected

5 = old wood affected

6 = dead down to the level of snow cover

7 = dead down to the ground surface

8 = dead

9 = sunscald, trunk spitting

10 = mechanical breakage related to weather conditions

11 = damage by rodents

*Dats were collected since 1992

**Only six plants survived in the test.

No damage of type 3, 6 and 9 occurred for this cultivar.

Table 2. Breakdown of *Syringa meyeri* 'Palibin' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	0	0	0	0	100	17	0	0	0	-	0	0	0	0
041-080	0	100	100	0	0	0	83	83	75	45	-	100	83	100	100
081-120	0	0	0	100	83	0	0	17	25	55	-	0	17	0	0
121-160	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	94	40	0	0	0	93	15	0	0	0	100	10	10	0	0
041-080	6	60	100	67	50	7	85	91	10	0	0	90	90	28	100
081-120	0	0	0	33	50	0	0	9	90	100	0	0	0	72	0
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	23	0	0	0	100	0	0	0	0					
041-080	0	77	91	100	100	-	-	-	-	-					
081-120	0	0	9	0	0	0	0	0	0	0					
121-160	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Syringa meyeri* 'Palibin' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	100	0	0	0	100	28	0	0	0	-	50	0	0	0
041-080	0	0	100	33	50	0	72	33	8	0	-	50	83	33	0
081-120	0	0	0	67	50	0	0	67	92	64	-	0	17	67	100
121-160	-	-	-	-	-	0	0	0	0	36	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	50	13	0	0	100	8	0	0	0	100	10	10	0	0
041-080	0	50	49	66	50	0	92	27	0	0	0	90	90	14	25
081-120	0	0	25	34	0	0	0	73	100	10	0	0	0	72	75
121-160	0	0	13	0	50	0	0	0	0	90	0	0	0	14	0
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	38	0	0	0	100	0	0	0	0					
041-080	0	62	64	33	0	-	-	-	-	-					
081-120	0	0	36	67	100	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

TAXUS CUSPIDATA

SIEBOLD & ZUCC.

Family:	Taxaceae
English name:	Japanese Yew
French name:	If du Japon
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub, of globular or bushy habit, can reach 8 m high in its natural habitat; in Quebec, however, it rarely grows taller than 5 m.

The dark reddish-brown bark is thin, peeling away in wide scales. The branches are spreading at the base and ascending at the tips. The young green shoots become brownish with age.

The small, green, rounded buds are covered with thin, triangular, and closely overlapping scales. The terminal buds are slightly larger than the lateral buds.

The carinate, falcate needles are flattened and slightly curved, with a prominent midvein. They are 1-3 cm long and are dark green above and slightly paler, with two yellowish-green bands, below. The foliage is dense and the needles remain on the shrub for roughly eight years.

Yews are dioecious. The male plants have globular, pedunculated pollen cones, while the female plants have single pedicellate ovules. The ovule is enclosed in an aril, a fleshy cup which is initially greenish but turns bright red when ripe. The first fall, the ovule ripens into a dark blue seed.

ORIGIN AND DISTRIBUTION

Several cultivars have been produced from this species, which is native to cold regions of Japan. It was introduced in North America in 1855.

USE

Ornamental: Although the cultivars are used more often than the species form in landscaping, the species is sometimes used for hedges or naturalized mass plantings.

DISEASES AND INSECTS

Root and collar rot occurs occasionally in the species, caused by various fungi (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.). Poor soil drainage is the main reason.

Yews are attacked by scale insects, with Fletcher scale being the most common. The black vine weevil (*Otiorhynchus sulcatus*) and the strawberry root weevil (*Otiorhynchus ovatus*) can also cause damage.

REQUIREMENTS

The species tolerates shade and grows very well in full sun. Undemanding, it tolerates calcareous soils but does best in slightly acid soils. A light annual pruning can be done to encourage the shrub to branch out.

When exposed to full sun in the winter, the foliage is susceptible to sunscald.

PROPAGATION

Seeds: The seeds, collected as soon as the aril turns red, are stripped of their pulp and stratified for eight months. Sowing is done the second spring. Plants propagated from seed grow slowly and, according to the literature, can only be sold after six years.

Cuttings: Several methods are used. The most common is to take semi-ripe heel cuttings in August from vigorous, ascending branches. A rooting hormone should be used and the cuttings should be rooted in a sand substrate on a table with bottom heat and mist unit.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 611 cuttings were taken on July 25, 1989 from ten-year-old parent plants measuring 60 cm high and 110 cm wide. The cuttings were dipped for 5 seconds in a 5,000-ppm IBA/50 % ethanol solution. They were planted in plug trays filled with a perlite-Promix® mixture (2:1; v:v), and placed under a mist unit in a heated greenhouse. Weekly fungicide treatments (Benomyl®) were given throughout the propagation period. Rooting began after seven weeks and the rooting rate was 90 % after 14 weeks. Seedlings were treated with a soluble fertilizer (10-52-10). On November 6, the first batch of 390 seedlings was potted up and fertilized with 10-52-10. A second batch of 190 seedlings was potted up in January 1990. On May 24, the seedlings were transplanted to the nursery, with a survival rate of 90 %. On October 23, they were dug up, puddled, and heeled in until the following spring; the winter survival rate was 100 %. On April 18, 1991, the seedlings were wrapped in plastic bags and placed in the cold store at 4 °C to await shipping in May.

Inclusion in testing network: Seedlings 10 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Mortality immediately after transplanting was high at almost all the sites, ranging between 25 % and 50 % of seedlings.

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 9 out of 10 seedlings did not survive the first two winters. The single surviving plant had no subsequent damage.

At Sainte-Clotilde, roughly 20 % of seedlings died during the first two winters. The surviving plants had no damage subsequently.

At Saint-Hyacinthe, close to half the seedlings died the first winter and 70 % had foliage browning the last winter. No other damage occurred.

Region 2

At Deschambault, nearly 30 % of seedlings died the first two winters. In addition, one third of the seedlings had foliage browning the first three winters. No damage occurred the last two winters.

At Sainte-Foy, the first winter, 9 % of seedlings died and 18 % suffered foliage browning. The second, third and fifth winters, 40 %, 12 % and 25 % of seedlings had frost damage to the branch tips.

No winter damage occurred at La Pocatière.

Region 3

At Normandin, single seedlings died the first and fourth winters. The first three winters, foliage browning occurred in 8 %, 25 % and 100 % of seedlings.

At Kapuskasing, mortality occurred every winter, killing 8 %, 27 %, 29 %, 40 % and 33 % of plants. The previous year's shoots were affected in one seedling during the first two winters and in 40 % of roses the fourth winter. In addition, one shrub had frost damage to the branch tips the first winter and 45 % had the same type of damage the following winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

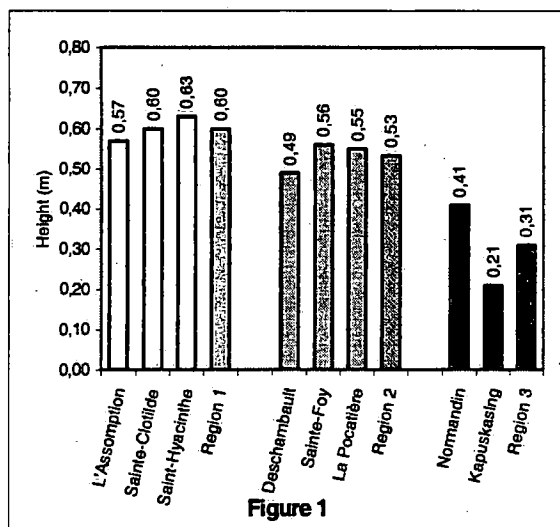


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

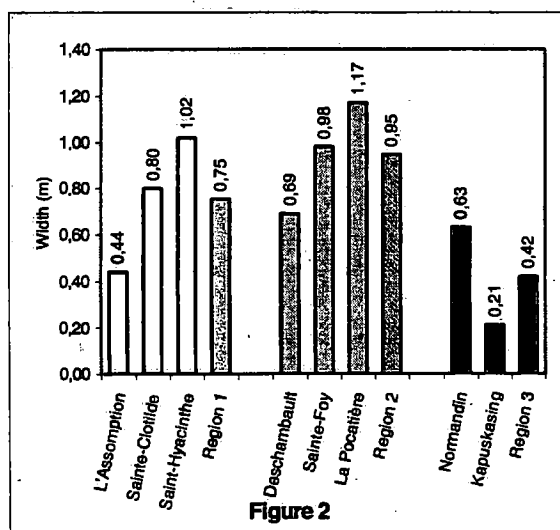


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth was slow the first two years at L'Assomption, Normandin and Kapuskasing. The shrubs were wider than they were tall by the end of the third growing season at all region 2 sites and by the end of the fourth growing season at Sainte-Clotilde, Saint-Hyacinthe and Kapuskasing.

Effect of pruning

This species only requires pruning to deal with winter damage, the intensity of which depends on the extent of the damage.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

The results show conclusively that the species is difficult to transplant, at least using the method employed in this trial. The mortality rate after transplanting was very high and the losses incurred the first two winters are very likely attributable to the weakness of the young seedlings' root systems.

At all the sites, foliage browning occurred in the parts of the branches that were above the snow cover. *Taxus* does not adapt well to being grown in the open or in clearings and usually suffers some damage as a result. Therefore, this understory species has problems when produced conventionally.

Growth was similar at all sites in regions 1 and 2; three growing seasons were required to obtain seedlings over 21 cm high and an additional two seasons were required to obtain plants over 41 cm high. Height growth was much slower at the region 3 sites.

HARDINESS EVALUATION

According to the literature, this species can survive as far as zone 4. Setting aside the significant mortality that occurred after transplanting, very few plants died as a result of severe winter conditions, except at Kapuskasing. This species can therefore survive as far as zone 2b.

Use also extends as far as zone 2b, with the proviso that growth will be very slow in this region.

The aerial portions of the branches located above the snow cover suffered frost damage at all the sites tested, which means that the species' full ornamental potential was not reached in the trial. However, it could be reached if adequate protection from the sun were provided in February, March and April.

BIBLIOGRAPHIC REFERENCES

2, 7, 17, 34

WRITTEN BY

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Michel Auger, Tech.

Table 1. Frequency of winter damage observed on *Taxus cuspidata* Siebold & Zucc. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
	1	2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	69							27				4	31
Sainte-Clotilde	95							4				1	5
Saint-Hyacinthe	77							9				14	23
REGION 2													
Deschambault	73							6				21	27
Sainte-Foy	79	15						2				4	21
La Pocatière	100												0
REGION 3													
Normandin	70							3				27	30
Kapuskasing	44	11		11				28				6	56

^a Key:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 6, 7, 9, 10 and 11 occurred for this species.

Table 2. Breakdown of *Taxus cuspidata* Siebold & Zucc. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	80	100	0	0	0	100	87	0	0	0	-	45	0	0	0
021-040	20	0	100	100	0	0	13	55	9	9	-	55	82	9	0
041-060	0	0	0	0	100	0	0	45	64	45	-	0	18	91	55
061-080	-	-	-	-	-	0	0	0	27	46	-	0	0	0	45
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	81	43	10	0	0	91	10	0	0	0	79	57	0	0	0
021-040	19	50	80	60	30	9	90	75	50	0	21	43	73	0	0
041-060	0	7	10	40	60	0	0	25	50	75	0	0	27	100	91
061-080	0	0	0	0	10	0	0	0	0	25	0	0	0	0	9
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	93	77	0	8	9	100	100	29	0	33					
021-040	7	23	92	92	36	0	0	71	100	67					
041-060	0	0	8	0	55	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Taxus cuspidata* Siebold & Zucc. plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	100	100	100	0	100	100	100	9	0	-	100	82	9	0
041-080	0	0	0	0	100	0	0	0	73	55	-	0	18	91	27
081-120	-	-	-	-	-	0	0	0	18	45	-	0	0	0	64
121-160	-	-	-	-	-	-	-	-	-	-	-	0	0	0	9
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	100	70	50	10	100	90	63	0	0	100	100	9	0	0
041-080	0	0	30	50	50	0	10	37	100	14	0	0	91	27	0
081-120	0	0	0	0	40	0	0	0	0	86	0	0	0	73	55
121-160	-	-	-	-	-	-	-	-	-	-	0	0	0	0	45
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	100	67	25	18	100	100	100	100	100					
041-080	0	0	33	75	73	-	-	-	-	-					
081-120	0	0	0	0	9	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

THUJA OCCIDENTALIS L.

(CONTROL 1991)

The sections Botanical Description, Origin and Distribution, Use, Requirements and Propagation can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume I (95-0070).

DISEASES AND INSECTS

Thuja species are potential primary hosts for various types of cedar rusts (*Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*), with *Thuja occidentalis* being the most susceptible species.

Alternaria, *Epicoccum* and root rot (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.) are other fungal diseases that may occur under favourable conditions.

The main insect pests affecting *Thuja* are scale insects (lecanium and Fletcher scale), spider mites, northern cedar bark beetle (*Phloeosinus canadensis*), black vine weevil (*Otiorhynchus sulcatus*) and strawberry root weevil.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: On December 5, 1989, 450 cuttings were taken from five-year-old parent plants measuring 50 cm tall and 40 cm wide. The cuttings were dipped for five seconds in a 10,000-ppm IBA/50 % ethanol solution, planted in plug trays filled with perlite and Promix® (2:1; v:v), and then placed under a mist unit in the greenhouse. Weekly fungicide treatments with Benomyl® were provided throughout the propagation period. Since the parent plants had been subjected to a summer drought, the rooting rate

after 12 weeks was only 50 %. Cuttings were then removed from the propagation tables and treated with soluble fertilizer (10-52-10). On May 25, 1990, 226 seedlings were transplanted to the nursery. On October 23, the seedlings were dug up, puddled and heeled in until the following spring. Winter survival was 100 %. On April 17, 1991, seedlings were packed in plastic bags and kept in the cold store at 4 °C to await shipping in May.

Inclusion in testing network: Seedlings 15 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 76 % of the plants suffered partial browning of the foliage during the second winter.

No damage occurred at Sainte-Clotilde.

At Saint-Hyacinthe, 33 % of the plants suffered partial browning of the foliage during the second and third winters.

Region 2

At Sainte-Foy, between 80 % and 100 % of the shrubs suffered frost damage to the branch tips during the last three winters. Partial browning of the foliage was observed in 5 %, 100 % and 85 % of the plants during the first three winters.

At Deschambault, partial browning of the foliage was observed on 33 % and 8 % of the shrubs during the third and fourth winters.

No damage was found at La Pocatière.

Region 3

At Normandin, 14 % of the plants suffered damage to the branch tips during the second winter.

At Kapuskasing, one plant died the third winter and another, which had shown little growth throughout the test, died the last winter. Partial browning of the foliage affected 10 %, 8 % and 27 % of the shrubs during the second, third and fourth winters respectively. The branch tips were affected in one plant (4 % and 8 %) during each of the second and third winters. Damage to one-year-old shoots was observed in 14 % of plants during the second winter.

Height and width growth

Figures 1 and 2 show the mean height and width of plants after five years of testing at each site in the three regions.

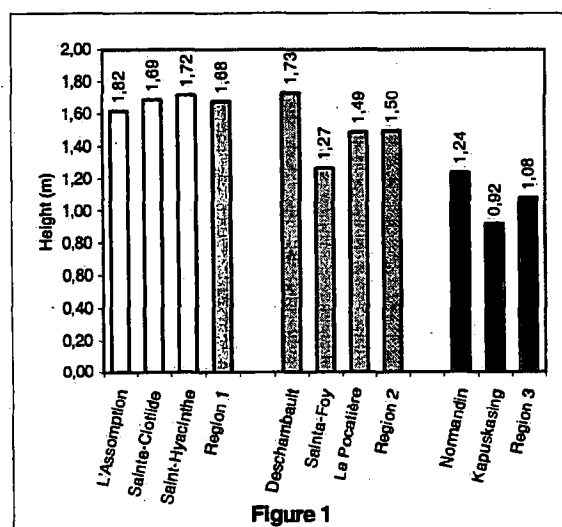


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

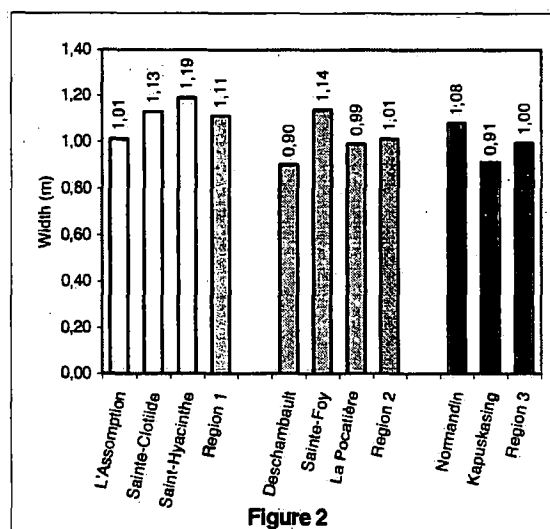


Figure 2. Mean width of trees at trial's end at each of the eight sites and three regions

Effect of pruning

Pruning was carried out strictly to remove portions of the plants damaged by the cold.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

Production of this species is generally faster in the south shore of the St-Lawrence. However, good results were also obtained at sites situated in hardiness zones 4 and 5, suggesting that the species can be produced in most regions of Quebec.

HARDINESS EVALUATION

According to the literature, this species is hardy to zone 3. This underestimates its hardiness, however, since no serious winter damage occurred even at Kapuskasing (zone 2a). Classifying the species as hardy to zone 2a is

conservative, since the species' performance during the trials suggests that it can even survive in zone 1b. It can be used in zone 2a, but growth will be slower.

The species' full ornamental potential was achieved at Sainte-Clotilde and La Pocatière.

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2, 4, 7, 17, 27, 28, 31, 33, 34, 35, 39, 66, 67, 73, 75

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Thuja occidentalis* L. (Control 1991) from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	10	11	14	
REGION 1											
L'Assomption	85									15	0
Sainte-Clotilde	100										2
Saint-Hyacinthe	86	1								13	0
REGION 2											
Deschambault	92									8	7
Sainte-Foy	22	55								23	61
La Pocatière	100										0
REGION 3											
Normandin	97	3									5
Kapuskasing	80	3	3				3	2		9	26

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Thuja occidentalis* L. (Control 1991) plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	100	75	75	75	100	55	75	75	75	100	10	75	75	75
051-100	0	0	8	0	0	0	45	25	0	0	0	90	25	0	0
101-150	0	0	17	25	8	0	0	0	17	17	0	0	0	25	0
151-200	0	0	0	0	17	0	0	0	8	8	0	0	0	0	25
201-250	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-050	100	15	75	75	75	100	10	75	75	75	100	34	75	75	75
051-100	0	85	0	0	0	0	90	25	8	0	0	66	8	0	0
101-150	0	0	25	8	0	0	0	0	17	17	0	0	17	17	8
151-200	0	0	0	17	17	0	0	0	0	8	0	0	0	8	17
201-250	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-050	100	86	75	75	75	100	43	92	83	75					
051-100	0	14	25	17	08	0	57	8	17	25					
101-150	0	0	0	8	17	-	-	-	-	-					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Thuja occidentalis* L. (Control 1991) plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	76	75	75	75	100	55	75	75	75	100	52	75	75	75
041-080	0	24	25	8	0	0	45	17	17	0	0	48	25	8	0
081-120	0	0	0	17	25	0	0	8	8	25	0	0	0	17	17
121-160	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	79	5	75	75	75	95	5	75	75	75	100	14	75	75	75
041-080	21	95	25	17	0	5	95	25	0	0	0	86	25	8	0
081-0120	0	0	0	8	25	0	0	0	25	17	0	0	0	17	25
121-160	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	90	75	75	75	100	95	83	83	75					
041-080	0	10	25	8	0	0	5	17	8	8					
081-120	0	0	0	17	25	0	0	0	9	17					
121-160	-	-	-	-	-	-	-	-	-	-					

THUJA OCCIDENTALIS L.

(CONTROL 1992)

The sections Botanical Description, Origin and Distribution, Diseases and Insects, Use, Requirements and Propagation can be found in *Hardiness and Growth of Woody Ornamental Plants in Quebec*, Volume I (95-0070) and Volume III (VT 008).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: On December 10, 1990, 400 cuttings were taken from five-year-old parent plants measuring 100 cm tall and 70 cm wide. The cuttings were dipped for five seconds in a 10,000-ppm IBA/50 % ethanol solution, planted in plug trays filled with perlite and Promix® (2:1; v:v), and then placed under a mist unit in the greenhouse and were sprinkled six seconds each hour. Basal heated systems was regulated to 25 °C Weekly fungicide treatments with Benomyl® were provided throughout the propagation period. The rooting rate after six weeks was 80 %. Cuttings were then removed from the propagation tables and treated with soluble fertilizer (10-52-10). On May 23, 1991, seedlings were transplanted to the nursery. On October 15, the seedlings were dug up, puddled and heeled in until the following spring. Winter survival was 100 %. On April 26, 1992, seedlings were packed in plastic bags and kept in the cold store at 4 °C to await shipping in May.

Inclusion in testing network: Seedlings 20 cm high were planted at eight test sites throughout Quebec and in northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the species over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage occurred at L'Assomption and Saint-Hyacinthe.

At Sainte-Clotilde, two plants suffered partial browning of the foliage during the first winter.

Region 2

At Sainte-Foy, 43 %, 52 %, 58 % and 42 % of the plants suffered damage to the branch tips during the first fourth winters.

The first winter, more than 50 % of the plants suffered partial browning of the foliage. The aerial portion of 58 % of the plants was dead to the snow cover level the last winter.

At Deschambault, a plant was submitted to mechanical breakage related to weather conditions the second winter and an other plant suffered partial browning of the foliage. This last damage was observed on 25 % of the shrubs the fourth winter.

No damage occurred at La Pocatière.

Region 3

At Normandin, a plant suffered damage to the branch tips during the first winter and two plants were submitted to mechanical breakage related to weather conditions the two last winters

At Kapuskasing, 40 % and 25 % of the plants died the first winter. Damage to one-year-old shoots was observed in 30 %, 8 %, 13 % and 14 % of plants during the three first and last winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the trees after five years at each site in the three regions.

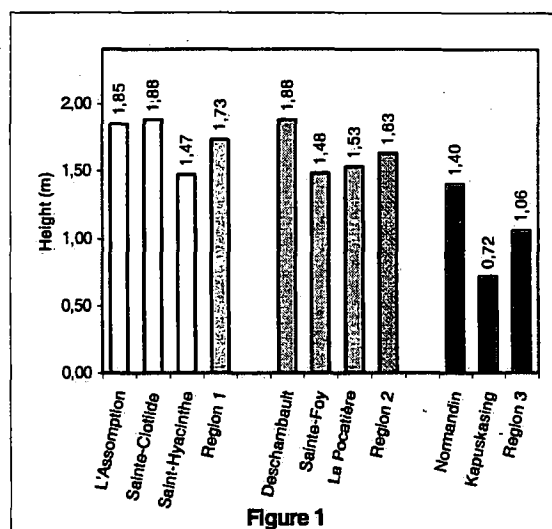


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

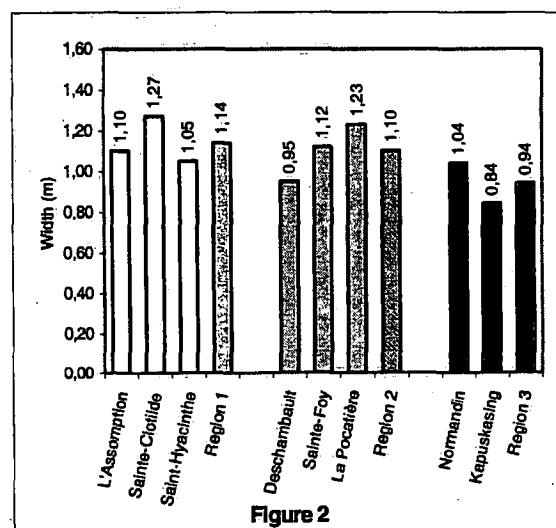


Figure 2. Mean width of trees at trial's end at each of the eight sites and three regions

Growth of plants was 100 % more important the second season at L'Assomption and La Pocatière and increases progressively in all other sites. It was always slower at Kapuskasing.

Effect of pruning

Pruning was carried out strictly to remove portions of the plants damaged by the cold.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

After two years, between 75 % and 95 % of the plants reached more than 51 cm in height in all sites, except at Kapuskasing. Growth of plants was more important in width in region 2 during the first growth's year and this difference decreased with the time. All plants reached a height superior to 1,0 m after four years of production at L'Assomption, Sainte-Clotilde and Deschambault. An other year was required at Sainte-Foy, La Pocatière and Normandin to obtain plants with a similar height.

Production of this species is generally faster in the south (Montreal region). However, good results were also obtained at sites situated in hardiness zones 4 and 5, suggesting that the species can be produced in most regions of Quebec, except Kapuskasing.

HARDINESS EVALUATION

According to the previous trials, this species is hardy to zone 2 and the species' performance during the trials suggests that it can even survive in zone 1b. It can be used as a specimen plant in zone 2b and in zone 3 for hedges. The species' full ornamental potential was achieved in zone 3 or at Sainte-Clotilde and La Pocatière in this trial. Growth in zone 2 is very slow.

BIBLIOGRAPHIC REFERENCES

2, 4, 7, 17, 27, 28, 31, 33, 34, 35, 39, 66, 67, 73, 75

WRITTEN BY

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Table 1. Frequency of winter damage observed on *Thuja occidentalis* L. (Control 1992) from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	10	11	14	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	98									2	2
Saint-Hyacinthe	100										0
REGION 2											
Deschambault	93							1		6	7
Sainte-Foy	39	39			12					10	61
La Pocatière	100										0
REGION 3											
Normandin	95	1						4			5
Kapuskasing	74		13				13				26

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 5, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Thuja occidentalis* L. (Control 1992) plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	95	5	0	0	0	90	25	0	0	0	95	20	0	0	0
051-100	5	95	17	0	0	10	75	100	0	0	5	80	75	25	0
101-150	0	0	75	75	8	0	0	0	100	5	0	0	25	75	81
151-200	0	0	8	25	67	0	0	0	0	64	0	0	0	0	19
201-250	0	0	0	0	25	0	0	0	0	31	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-050	90	5	0	0	0	57	10	0	0	0	100	10	0	0	0
051-100	10	95	25	0	0	43	90	83	25	0	0	90	50	17	0
101-150	0	0	75	58	8	0	0	17	75	50	0	0	50	75	50
151-200	0	0	0	42	59	0	0	0	0	50	0	0	0	8	50
201-250	0	0	0	0	33	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-050	82	6	0	0	0	100	100	88	12	12					
051-100	18	94	58	25	0	0	0	12	88	88					
101-150	0	0	42	75	75	-	-	-	-	-					
151-200	0	0	0	0	25	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Thuja occidentalis* L. (Control 1992) plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	90	8	0	0	100	85	40	0	0	100	55	40	0	0
041-080	0	10	92	58	0	0	15	60	62	0	0	45	60	50	8
081-120	0	0	0	42	92	0	0	0	38	75	0	0	0	50	87
121-160	0	0	0	0	8	0	0	0	0	25	0	0	0	0	5
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	80	10	0	0	0	76	19	0	0	0	100	5	0	0	0
041-080	20	90	100	58	8	24	81	100	8	0	0	95	75	8	0
081-120	0	0	0	42	92	0	0	0	75	83	0	0	25	92	42
121-160	-	-	-	-	-	0	0	0	17	17	0	0	0	0	58
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	29	0	0	0	100	50	25	13	12					
041-080	0	71	75	8	8	0	50	75	25	13					
081-120	0	0	25	92	92	0	0	0	62	75					
121-160	-	-	-	-	-	-	-	-	-	-					

THUJA OCCIDENTALIS

'CLOTH OF GOLD'

Family:	Cupressaceae
English name:	Cloth of Gold American Arborvitae
French name:	Thuya occidental 'Cloth of Gold'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small, bushy tree takes on a columnar habit with age, growing to 4-5 m tall under ideal circumstances. At Laval University's Jardin Roger-Van den Hende in Sainte-Foy, however, it only reached 2 m high and 1 m wide after 15 years.

The bark of the young twigs is yellowish, turning golden brown with age.

New leaves are gold-coloured, but turn yellowish green in summer and brownish as winter approaches.

ORIGIN AND DISTRIBUTION

No information is available in the literature on this cultivar. It comes from the private collection of a plant geneticist, Mr. Vandal, in Quebec City.

USE

Ornamental: This cultivar can be used as a specimen plant or in mass plantings to take advantage of the colour of the foliage. It appears to best advantage when grown with dark-foliaged conifers to add contrast. It is slow growing.

REQUIREMENTS

This cultivar, like other *Thuja* cultivars with golden foliage, prefers a sunny location but can adapt to different conditions.

Like most conifers, its foliage is susceptible to browning in late winter. Exposure to full sun in spring should be avoided and it is best to screen plants from the sun using jute or white geotextile.

DISEASES AND INSECTS

Thuja species are potential primary hosts for various types of cedar rusts (*Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*), with *Thuja occidentalis* being the most susceptible species. Cultivars are more resistant to these rusts.

Alternaria, *Epicoccum* and root rot (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.) are other fungal diseases that may occur under favourable conditions.

The main insect pests affecting *Thuja* comprise scale insects (Iecanium and Fletcher scale), spider mites, northern cedar bark beetle (*Phloeosinus canadensis*), black vine weevil (*Otiorhynchus sulcatus*) and strawberry root weevil.

PROPAGATION

Cuttings: Cuttings from the current year's wood with the heel, taken between November and March, after the first heavy frosts, will root well.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: 416 cuttings (15 cm high) were taken on May 23, 1990 from parent plants that were about ten years old. The cuttings were dipped for five seconds in an 8,000-ppm IBA/50 % ethanol solution and then rinsed in tap water. They were then soaked in a fungicide solution of Benomyl-Captan®. The cuttings were planted in plug trays filled with peat moss and perlite (1:3; v:v), and then placed under a mist unit (Mist-A-Matic®). The rooting rate was 79 % after 85 days. The plants were potted up on

August 16 in Fertil-Pot[®] filled with a peat moss and perlite medium (3:2; v:v) and kept in an unheated greenhouse after being hardened off for one week. The next two weeks, they were treated with a soluble fertilizer (20-20-20) and growth continued throughout autumn. In mid-November, the plants were wrapped in plastic bags perforated with a hair pin and kept in the cold store at 0 °C. In early May of 1991, they were wrapped and returned to the cold store at 4 °C to await shipping a few days later.

Inclusion in testing network: Seedlings 15 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 17 %, 20 %, 38 % and 20 % of the plants died during each of the first four winters respectively, leaving only four shrubs for the trials. Two plants suffered damage to the stem tips during the second winter. Foliage browning occurred in 72 % of seedlings during the first winter and 13 % the second winter. No damage was observed subsequently.

At Sainte-Clotilde, only two seedlings died the first winter and one the following winter.

At Saint-Hyacinthe, one seedling died the first winter and two the following winter. The second winter, 45 % and 20 % of plants showed frost damage to the branch tips and foliage browning respectively. No other damage was observed.

Region 2

At Sainte-Foy, foliage browning was observed in all plants during the first two winters and on 25 % of shrubs the following winter. Frost damage to the branch tips affected 8 %, 25 % and 75 % of seedlings during the last three winters.

At Deschambault, 10 %, 5 % and 10 % of plants died the first three winters. Foliage browning was observed every winter on almost all the plants, except the last winter, when it was observed in only 40 % of shrubs.

Foliage browning occurred on all shrubs at La Pocatière during the first three winters. During the last winter, one shrub suffered damage to the previous year's shoots.

Region 3

At Normandin, 20 % and 56 % of seedlings died the first two winters and 50 % and 13 % of plants suffered frost injuries to the branch tips. In addition, 15 % of plants suffered frost damage to the one-year-old shoots in the first winter and 17 % of shrubs suffered from foliage browning the final winter.

At Kapuskasing, all the plants died in the second or third winter. Plants that survived had frost injury to the branch tips and the previous year's shoots, as well as foliage browning.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years of testing at each site in the three regions.

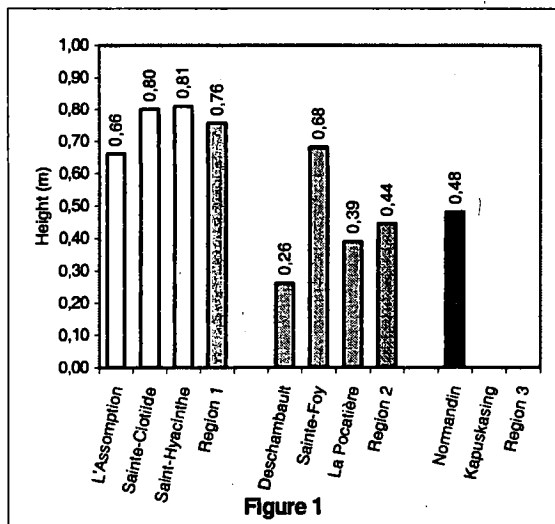


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and the three regions

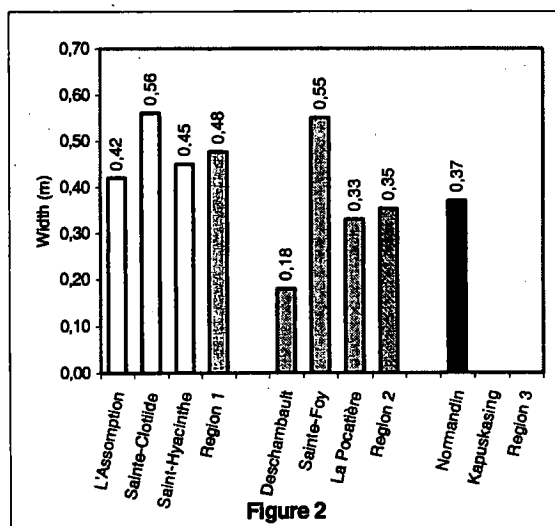


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and the three regions

Heights were relatively homogenous within region 1. Growth was particularly slow at the Deschambault and La Pocatière sites.

Widths varied greatly in region 2. Although there were fairly significant differences between sites, growth increased every year.

Effect of pruning

Light pruning was done each year at Deschambault. No other pruning was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years it should take to obtain a given height and width.

Getting field-grown plants established is very difficult during the first few years, as shown by the very slow growth and high mortality. In addition, most foliage browning occurs during the first three winters.

In 80 % of cases, five growing seasons were required to obtain shrubs over 60 cm high at the Saint-Hyacinthe and Sainte-Clotilde sites. The corresponding percentage was about 50 % for L'Assomption and Sainte-Foy and around 33 % at Normandin.

Production of field-grown plants is not recommended in Quebec.

HARDINESS EVALUATION

The significant damage that occurred in hardiness zone 2 shows that the cultivar can only survive a few years there. In zones 4 and 5, plants that make it through the first two or three years and become established seem to grow steadily and suffer relatively little damage. The cultivar survives and can be used as far as zone 4.

The parent plant at the Jardin Roger-Van den Hende is over 15 years old, has never suffered significant damage and has a good annual growth rate.

BIBLIOGRAPHIC REFERENCES

2, 7

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Thuja occidentalis* 'Cloth of Gold' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	14	
REGION 1											
L'Assomption	61	4					18			17	39
Sainte-Clotilde	97						3				3
Saint-Hyacinthe	83	9					4			4	17
REGION 2											
Deschambault	16						4			80	84
Sainte-Foy	33	22								45	67
La Pocatière	40		2							58	60
REGION 3											
Normandin	65	12	3				15			5	35
Kapuskasing*	0	48	4				37			11	100

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

No damage of type 5, 6, 7, 9, 10 and 11 occurred for this cultivar.

Table 2. Breakdown of *Thuja occidentalis* 'Cloth of Gold' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	60	63	20	0	100	79	0	0	0	-	60	42	0	0
021-040	0	40	25	60	25	0	21	91	17	8	-	40	50	50	0
041-060	0	0	12	0	25	0	0	9	42	9	-	0	8	40	20
061-080	0	0	0	20	25	0	0	0	41	33	-	0	0	10	40
081-100	0	0	0	0	0	0	0	0	0	25	-	0	0	0	30
101-120	0	0	0	0	25	0	0	0	0	25	-	0	0	0	10
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	95	84	91	50	30	100	38	25	0	0	94	100	73	36	10
021-040	5	16	9	50	70	0	62	58	41	8	6	0	27	64	40
041-060	-	-	-	-	-	0	0	17	42	33	0	0	0	0	50
061-080	-	-	-	-	-	0	0	0	17	25	-	-	-	-	-
081-100	-	-	-	-	-	0	0	0	0	34	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing**									
	91	92	93	94	95	91	92	93	94	95					
001-020	95	87	50	50	17	100	62	100	-	-					
021-040	5	13	17	33	33	0	38	0	-	-					
041-060	0	0	33	17	17	-	-	-	-	-					
061-080	0	0	0	0	33	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

**All plants were dead after the third winter.

Table 3. Breakdown of *Thuja occidentalis* 'Cloth of Gold' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	100	87	20	0	100	100	18	8	0	-	100	92	10	10
021-040	0	0	13	60	50	0	0	82	67	25	-	0	8	80	40
041-060	0	0	0	20	25	0	0	0	25	33	-	0	0	10	30
061-080	0	0	0	0	25	0	0	0	0	42	-	0	0	0	20
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	95	100	100	90	70	100	86	34	8	0	100	95	91	36	10
021-040	5	0	0	10	30	0	14	66	83	17	0	5	9	64	60
041-060	-	-	-	-	-	0	0	0	9	50	0	0	0	0	30
061-080	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing**									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	100	50	33	33	100	100	100	-	-					
021-040	0	0	50	50	17	-	-	-	-	-					
041-060	0	0	0	17	50	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

**All plants were dead after the third winter.

THUJA OCCIDENTALIS

'GLOBOSA AUREA'

Family:	Cupressaceae
English name:	Gold American Arborvitae
French name:	Thuja occidentalis globulaire doré
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub, of regular, globular habit, can grow to 3.0 m high and close to 1.5 m wide. It is densely branched, containing a number of ascending branches. The young shoots are flattened in closely packed sprays of haphazardly arranged foliage.

The foliage is dense. The scale-like leaves are golden yellow in the spring, turning greenish yellow as they mature and then bronze in the winter.

Growth is moderate.

ORIGIN AND DISTRIBUTION

No information was found for this cultivar.

USE

Ornamental: Mainly used as a specimen plant, the cultivar is also grown with other plants. It is prized for the colour of its foliage and rounded shape.

REQUIREMENTS

The shoots are yellow in plants grown in full sun. In the shade, they turn green and the foliage is less dense. This conifer prefers a deep, humic soil and grows better in a damp location.

As in most conifers, the foliage is susceptible to browning at the end of winter. Direct exposure to the sun in spring

is to be avoided and the plant should be protected from the sun with a screen (jute, white geotextile, etc.).

DISEASES AND INSECTS

Thuja species are potential primary hosts for various types of cedar rusts (*Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*), with *Thuja occidentalis* being the most susceptible. Cultivars are probably more resistant to cedar rust than the species form.

Alternaria, *Epicoccum* and collar rot (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.) are other fungal diseases that may occur under favourable conditions.

The main insect pests affecting *Thuja* comprise scale insects (lecanium and Fletcher scale), spider mites, northern cedar bark beetle (*Phloeosinus canadensis*), black vine weevil (*Otiorhynchus sulcatus*) and strawberry root weevil (*Otiorhynchus ovatus*).

PROPAGATION

Cuttings: Cuttings are taken in late spring and planted in pots filled with an acid substrate. They should be treated with rooting hormones and placed under a mist unit. The success rate is rarely over 60 %.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: On May 22, 1990, 395 cuttings were taken from roughly ten-year-old parent plants. The cuttings were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. They were then immersed in a Captan-Benomyl® solution. They were planted in plug trays filled with a peat-perlite mixture (1:3; v:v), and then placed under a mist unit (Mist-A-Matic®). The rooting rate was 55 % after 86 days. The seedlings were potted up on August 16 in Fertil Pot® in a

peat-perlite mixture (3:2; v:v), and kept in an unheated greenhouse after a week-long hardening-off period. They were treated the two following weeks with a soluble fertilizer (20-20-20). In mid-November, the seedlings were put in plastic bags perforated with a hatpin and put in the cold store at 0 °C. In early May 1991, they were wrapped and returned to the cold store at 4 °C, then shipped a few days later.

Inclusion in testing network: Seedlings 11 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage occurred at L'Assomption, except for one seedling that died the first winter.

No damage occurred at Sainte-Clotilde.

At Saint-Hyacinthe, two seedlings (10 %) did not survive the first winter. The only other damage was foliage browning, which occurred in 32 % of the seedlings the second winter.

Region 2

At Sainte-Foy, foliage browning occurred the first three winters in 52 %, 95 % and 33 % of plants. The branch tips were affected in 33 %, 25 % and 58 % of shrubs the last three winters.

Foliage browning was observed all five winters at Deschambault in 62 %, 38 %, 25 %, 17 % and 42 % of shrubs.

At La Pocatière, all seedlings suffered foliage browning the second winter only.

Region 3

At Normandin, 47 % and 33 % of seedlings had frost damage to the branch tips the first two winters. One plant suffered foliage browning the following winter. No damage occurred subsequently.

At Kapuskasing, 8 % and 27 % of shrubs died the third and fourth winters. Frost damage to the branch tips occurred the first two and the last two winters in 90 %, 33 %, 83 % and 50 % of plants. The annual shoots were affected in 10 % and 8 % of shrubs the second and third winters. Foliage browning occurred in 57 %, 73 % and 38 % of seedlings the second and last two winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

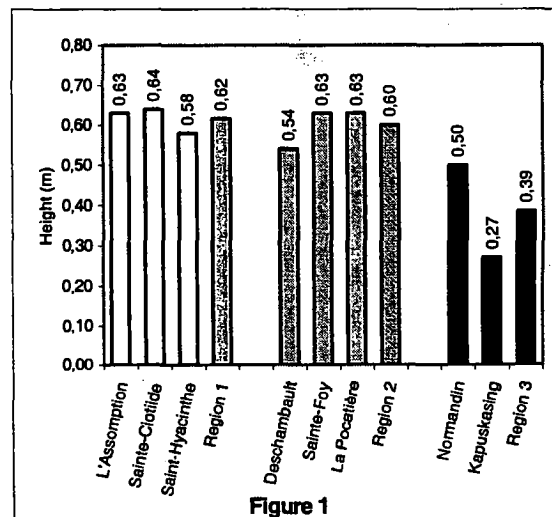


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

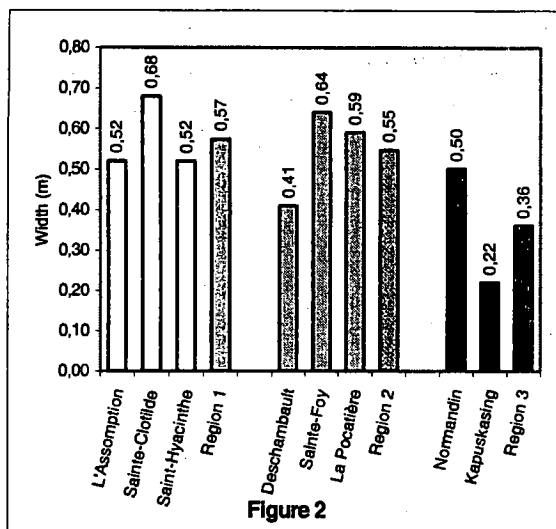


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth was regular at all sites, but was slower at Kapuskasing.

Effect of pruning

Light pruning was done at Normandin and Kapuskasing the third and fourth years. No other pruning was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Growth in this cultivar was very homogenous at each site. In 90 % of cases, four growing seasons were required to obtain seedlings 41-60 cm tall at L'Assomption, Sainte-Clotilde, Sainte-Foy and La Pocatière. At Saint-Hyacinthe and Deschambault, an extra year was required to obtain plants of comparable height. Shrubs were not as wide at L'Assomption and Deschambault.

Production is recommended for sites in regions 1 and 2.

HARDINESS EVALUATION

The mortality that occurred in zone 2a during the third and fourth winters shows that the cultivar may succumb during particularly harsh winters in this zone and therefore survival is risky. The cultivar can survive as far as zone 2b.

It can also be used as far as zone 2b, but only achieves its full ornamental potential in zone 5b.

BIBLIOGRAPHIC REFERENCES

2, 7, 27

WRITTEN BY

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Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Thuja occidentalis* 'Globosa Aurea' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	4	5	6	7	8	9	10	11	14	
REGION 1												
L'Assomption	99						1					1
Sainte-Clotilde	100											0
Saint-Hyacinthe	92						2				6	8
REGION 2												
Deschambault	63										37	37
Sainte-Foy	40	23									37	60
La Pocatière	80										20	20
REGION 3												
Normandin	82	16									2	18
Kapuskasing	2	51	3	4			7				33	98

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	14 = partial browning of the foliage

No damage of type 6, 7, 9, 10 and 11 occurred for this cultivar.

Table 2. Breakdown of *Thuja occidentalis* 'Globosa Aurea' plants by marketable height category from 1991 to 1995

REGION 1															
Height	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
(cm)	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	40	0	0	0	100	67	0	0	0	-	25	8	0	0
021-040	0	60	91	0	0	0	33	100	8	0	-	75	92	75	8
041-060	0	0	9	91	64	0	0	0	92	42	-	0	0	25	75
061-080	0	0	0	9	36	0	0	0	0	58	-	0	0	0	17
REGION 2															
Height	Deschambault					Sainte-Foy					La Pocatière				
(cm)	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	43	0	0	0	100	5	0	0	0	100	29	0	0	0
021-040	0	57	100	50	25	0	95	92	8	0	0	71	67	8	0
041-060	0	0	0	50	33	0	0	8	92	42	0	0	33	92	33
061-080	0	0	0	0	42	0	0	0	0	58	0	0	0	0	67
REGION 3															
Height	Normandin					Kapuskasing									
(cm)	91	92	93	94	95	91	92	93	94	95					
001-020	100	10	8	0	0	100	67	83	64	25					
021-040	0	90	92	75	25	0	33	17	36	63					
041-060	0	0	0	25	75	0	0	0	0	12					
061-080	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Thuja occidentalis* 'Globosa Aurea' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	85	18	0	0	100	76	0	0	0	-	75	33	0	0
021-040	0	15	82	82	0	0	24	75	33	0	-	25	67	58	17
041-060	0	0	0	18	82	0	0	25	67	17	-	0	0	42	83
061-080	0	0	0	0	18	0	0	0	0	83	-	0	0	0	0
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	95	48	42	8	0	86	19	0	0	0	95	52	0	0	0
021-040	5	52	58	67	50	14	81	92	25	0	5	48	92	17	0
041-060	0	0	0	25	50	0	0	8	75	33	0	0	8	83	58
061-080	-	-	-	-	-	0	0	0	0	67	0	0	0	0	42
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	95	8	0	0	95	86	75	64	50					
021-040	0	5	92	75	25	5	14	25	36	50					
041-060	0	0	0	25	67	-	-	-	-	-					
061-080	0	0	0	0	8	-	-	-	-	-					

*Data were collected since 1992.

THUJA OCCIDENTALIS

'HOLMSTRUP'

Family:	Cupressaceae
English name:	Holmstrup American Arborvitae
French name:	Thuja occidentalis 'Holmstrup'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This compact shrub, of erect, conical habit, can grow to 3.0 m high and 0.6 m wide.

It has numerous shoots. The young, vertical shoots are curved and look like a fan.

The extremely dense foliage is dark green during the growing season, but turns a slightly bronzy colour in the cold of winter.

The small cones mature in late summer.

Growth is slow in this cultivar.

ORIGIN AND DISTRIBUTION

Originating in Denmark, this cultivar was introduced in Canada in 1965.

USE

Ornamental: The cultivar is used alone or with other plants. It is prized for its decorative habitat and slow growth. It can be used in rock gardens and mass plantings.

REQUIREMENTS

This shrub grows equally well in full sun and partial shade. It prefers deep, moist soil. A light annual pruning maintains the compact form.

DISEASES AND INSECTS

Thuja species are potential primary hosts for various types of cedar rusts (*Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*), with *Thuja occidentalis* being the most susceptible. Cultivars are probably more resistant to cedar rust than the species form.

Alternaria, *Epicoccum* and collar rot (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.) are other fungal diseases that may occur under favourable conditions.

The main insect pests affecting *Thuja* comprise scale insects (lecanium and Fletcher scale), spider mites, northern cedar bark beetle (*Phloeosinus canadensis*), black vine weevil (*Otiorhynchus sulcatus*) and strawberry root weevil (*Otiorhynchus ovatus*).

PROPAGATION

Cuttings: Cuttings taken in August or September and planted in a cold frame or greenhouse flat root readily. The use of auxin compounds increases the success rate.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: On May 23, 1990, 499 cuttings (8 cm) were taken from roughly ten-year-old parent plants. The cuttings were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. They were then immersed in a Captan-Benomyl® solution. They were planted in plug trays filled with a peat-perlite mixture (1:3; v:v), and then placed under a mist unit (Mist-A-Matic®). The rooting rate was 90 % after 85 days. The seedlings were potted up on August 16 in Fertil Pot® in a peat-perlite mixture (3:2; v:v), and kept in an unheated greenhouse after a week-long hardening-off period. They were treated the two following weeks with a soluble fertilizer (20-20-20). In mid-November, the seedlings were

put in plastic bags perforated with a hatpin and put in the cold store at 0 °C. In early May 1991, they were wrapped and returned to the cold store at 4 °C, then shipped a few days later.

Inclusion in testing network : Seedlings 15 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, 25 % of shrubs suffered partial foliage browning during the last winter. No other damage was observed.

At Sainte-Clotilde, one seedling died the first winter. No other damage was observed.

At Saint-Hyacinthe, partial foliage browning was observed in 67 % of shrubs the second and third winters.

Region 2

At Sainte-Foy, 48 %, 33 %, 92 % and 100 % of shrubs suffered frost damage to the branch tips the last four winters.

At Deschambault, one seedling had foliage browning the second winter. No other damage was observed.

At La Pocatière, 10 % of seedlings suffered frost damage to the aerial portion above the snow cover during the second winter. No other damage was observed.

Region 3

At Normandin, one seedling had damage to the branch tips the second winter. No other damage was observed.

At Kapuskasing, 24 %, 10 % and 5 % of seedlings had damage to the branch tips, previous year's shoots and foliage respectively during the second winter. No other damage was observed.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

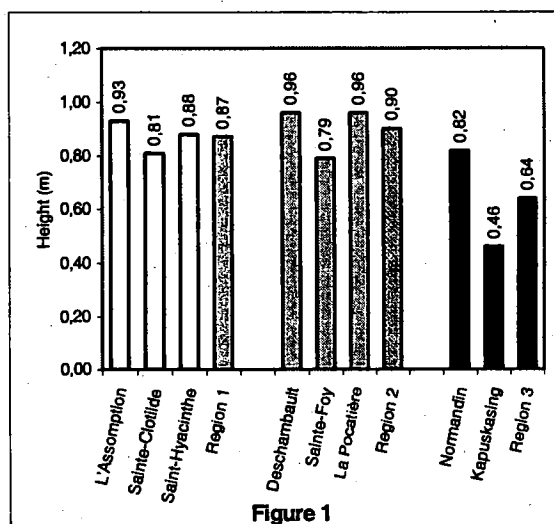


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

Growth was regular at all sites. Width growth was particularly homogenous in regions 1 and 2.

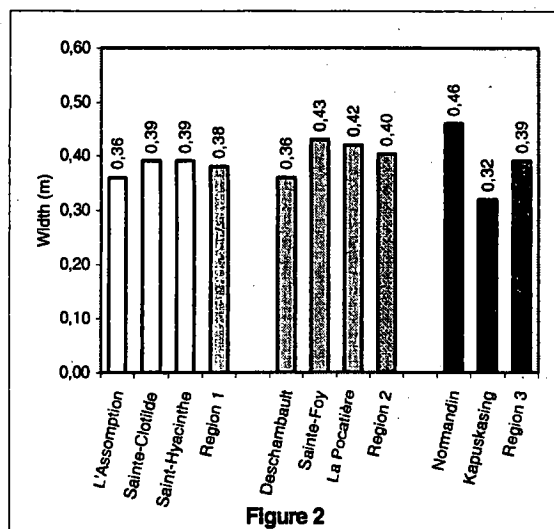


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning was done except for light pruning at Sainte-Foy and La Pocatière to deal with winter damage.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Height growth in this cultivar was quicker in region 2. It can be produced in regions 1 and 2 and at Normandin.

HARDINESS EVALUATION

According to the literature, the species and its cultivars are hardy to zone 3. The cultivar can survive and be used as far as zone 2a.

The cultivar can achieve its full ornamental potential as far as zone 2b when well established. The parent plant at the Jardin Roger-Van den Hende is over 15 years old and has

not suffered any significant damage. Annual growth is good, unlike in the young seedlings at the Sainte-Foy site.

BIBLIOGRAPHIC REFERENCES

2, 7, 27, 33, 67.

WRITTEN BY

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Thuja occidentalis* 'Holmstrup' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
		2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	95											5	5
Sainte-Clotilde	99							1					1
Saint-Hyacinthe	73											27	27
REGION 2													
Deschambault	99											1	1
Sainte-Foy	45	55											55
La Pocatière	98					2							2
REGION 3													
Normandin	99	1											1
Kapuskasing	91	6		2								1	9

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7, 9, 10 and 11 occurred for this cultivar.

Table 2. Breakdown of *Thuja occidentalis* 'Holmstrup' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	5	0	0	0	100	0	0	0	0	-	5	0	0	0
021-040	0	90	8	0	0	0	100	50	0	0	-	76	8	0	0
041-060	0	5	92	0	0	0	0	50	33	0	-	19	84	50	0
061-080	0	0	0	100	0	0	0	0	67	58	-	0	8	50	17
081-100	0	0	0	0	92	0	0	0	0	42	-	0	0	0	75
101-120	0	0	0	0	8	-	-	-	-	-	-	0	0	0	8
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	24	0	0	0	100	0	0	0	0	100	0	0	0	0
021-040	0	76	42	0	0	0	81	17	0	0	0	100	0	0	0
041-060	0	0	58	17	0	0	19	75	0	0	0	0	50	0	0
061-080	0	0	0	75	9	0	0	8	83	67	0	0	50	42	0
081-100	0	0	0	8	58	0	0	0	17	33	0	0	0	58	75
101-120	0	0	0	0	33	-	-	-	-	-	0	0	0	0	25
REGION 3															
Height (cm)	Normandin					Kapusking									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	67	0	0	0	100	38	25	8	0					
021-040	0	33	17	0	0	0	57	75	67	33					
041-060	0	0	83	67	0	0	5	0	25	67					
061-080	0	0	0	33	58	-	-	-	-	-					
081-100	0	0	0	0	42	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Dats were collected since 1992.

Table 3. Breakdown of *Thuja occidentalis* 'Holmstrup' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	90	5	0	0	0	100	5	0	0	0	-	0	0	0	0
011-020	10	90	34	0	0	0	95	50	0	0	-	95	42	0	0
021-030	0	0	66	75	8	0	0	33	25	0	-	5	58	100	0
031-040	0	5	0	25	75	0	0	17	75	92	-	0	0	0	92
041-050	0	0	0	0	17	0	0	0	0	8	-	0	0	0	8
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-010	14	0	0	0	0	24	0	0	0	0	67	0	0	0	0
011-020	86	85	8	0	0	76	67	0	0	0	33	100	0	0	0
021-030	0	15	92	92	0	0	33	92	0	0	0	0	100	67	0
031-040	0	0	0	8	100	0	0	8	100	33	0	0	0	33	50
041-050	-	-	-	-	-	0	0	0	0	67	0	0	0	0	50
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-010	67	5	0	0	0	48	24	0	0	0					
011-020	33	62	0	0	0	52	76	42	17	0					
021-030	0	33	33	8	0	0	0	58	75	42					
031-040	0	0	67	92	17	0	0	0	8	50					
041-050	0	0	0	0	83	0	0	0	0	8					

*Datas were collected since 1992.

THUJA OCCIDENTALIS

'LUTESCENS'

Family:	Cupressaceae
English name:	Lutescens American Arborvitae
French name:	Thuja occidentalis 'Lutescens'
Synonym:	Thuja occidentalis 'Wareana Lutescens'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small tree, of conical, fastigate form, can grow to 4-5 m tall and 2 m wide. The erect branches give the shrub a narrow, dense look. The young light-green shoots are short and less densely packed.

The compact foliage consists of flattened sprays. The pale yellowish-green leaves turn to a creamy white tinged with green as they mature.

Cones have not been observed on the cultivar.

Growth is moderate.

ORIGIN AND DISTRIBUTION

No specific information has been found on this cultivar.

USE

Ornamental: Planted as a specimen plant or in a mass planting, the cultivar is prized for its delicate colour and beautiful natural shape.

REQUIREMENTS

Full sun allows the shrub to retain its characteristic colour. It prefers deep, moist rich soil and a site protected from the wind. It withstands pruning well.

As in most conifers, the foliage is susceptible to browning at the end of winter. Direct exposure to the sun in spring

is to be avoided and the plant should be protected from the sun with a screen (jute, white geotextile, etc.).

DISEASES AND INSECTS

Thuja species are potential primary hosts for various types of cedar rusts (*Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*), with *Thuja occidentalis* being the most susceptible. Cultivars are probably more resistant to cedar rust than the species form.

Alternaria, *Epicoccum* and collar rot (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.) are other fungal diseases that may occur under favourable conditions.

The main insect pests affecting *Thuja* comprise scale insects (Iecanium and Fletcher scale), spider mites, northern cedar bark beetle (*Phloeosinus canadensis*), black vine weevil (*Otiorhynchus sulcatus*) and strawberry root weevil (*Otiorhynchus ovatus*).

PROPAGATION

Cuttings: Cuttings taken in spring, treated with an auxin compound and rooted in a slightly acid substrate, give good results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: On May 22, 1990, 511 cuttings (10 cm) were taken from roughly fifteen-year-old parent plants. The cuttings were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed in tap water. They were then immersed in a Captan-Benomyl® solution. They were planted in plug trays filled with a peat-perlite mixture (1:3; v:v), and then placed under a mist unit (Mist-A-Matic®). The rooting rate was 62 % after 85 days. The seedlings were potted up on August 15 in Fertil Pot® in a peat-perlite mixture (3:2; v:v),

and kept in an unheated greenhouse after a week-long hardening-off period. They were treated the two following weeks with a soluble fertilizer (20-20-20). In mid-November, the seedlings were put in plastic bags perforated with a hatpin and put in the cold store at 0 °C. In early May 1991, they were wrapped and returned to the cold store at 4 °C, then shipped a few days later.

Inclusion in testing network: Seedlings 8 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, one seedling died the second winter. One third of the seedlings suffered foliage browning the first winter. No other damage occurred.

No damage occurred at Sainte-Clotilde.

At Saint-Hyacinthe, a single seedling died the first winter.

Region 2

At Sainte-Foy, 29 %, 8 %, 50 % and 100 % of the shrubs suffered frost damage to the branch tips the last four winters.

At Deschambault, single seedlings died the first two winters. Frost damage to the foliage was observed in 9 % and 5 % of seedlings during the same period.

No damage occurred at La Pocatière.

Region 3

No damage occurred at Normandin.

At Kapuskasing, frost damage to the foliage occurred in 8-33 % of shrubs each winter. The branch tips were affected in 67 % of plants the second winter and in 8 %, the third. The fourth winter, 17 % of shrubs suffered damage to the previous year's shoots and, the fifth winter, the same percentage suffered mechanical breakage.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

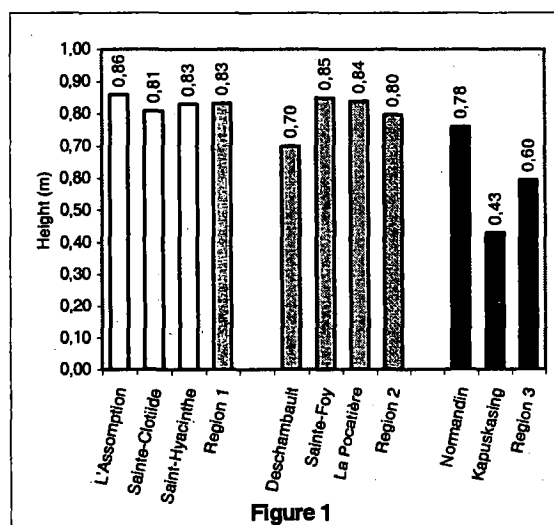


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

Growth was regular at all sites, but was rather slow at Kapuskasing. At Sainte-Clotilde, plants were wider than they were tall at trial's end.

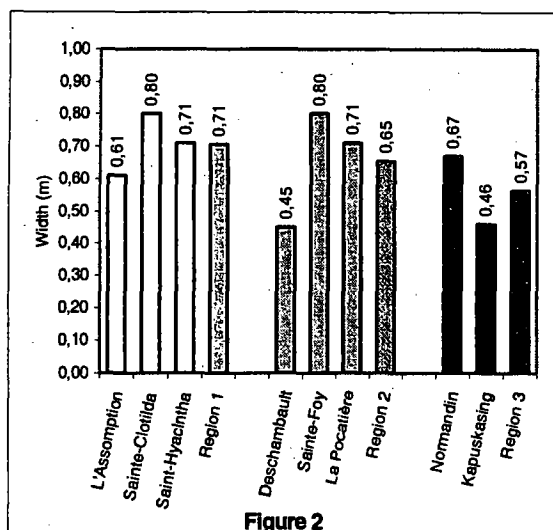


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Effect of pruning

Light pruning was done at Kapuskasing to deal with winter damage.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Over 83 % of shrubs reached a height of 41-60 cm after three growing seasons at Saint-Hyacinthe, Sainte-Foy, La Pocatière and Normandin. An additional year was required at the other sites, except Kapuskasing, where this height was not achieved during the trial.

The cultivar can be produced in hardiness zones 2b to 5b.

HARDINESS EVALUATION

The trial results show that the cultivar can survive at least as far as zone 2a. Its use in zone 2a may be limited,

however, due to its propensity for foliage browning in this zone, which decreases its ornamental value in spring.

The cultivar achieved its full ornamental potential in the region 1 sites, as well as at La Pocatière and Normandin. However, the Normandin plants did not grow over 1 m high, and therefore were entirely covered with snow during the coldest months.

BIBLIOGRAPHIC REFERENCES

2, 7, 67

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Thuja occidentalis* 'Lutescens' from 1992 to 1996

Test site	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	4	5	6	7	8	9	10	11	14	
REGION 1												
L'Assomption	92						1				7	8
Sainte-Clotilde	100											0
Saint-Hyacinthe	99						1					1
REGION 2												
Deschambault	93	2					2				3	7
Sainte-Foy	62	37		1								38
La Pocatière	100											0
REGION 3												
Normandin	100	15										0
Kapuskasing	55		3						3		24	45

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Thuja occidentalis* 'Lutescens' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	33	0	0	0	100	43	0	0	0	-	15	0	0	0
021-040	0	67	42	0	0	0	57	33	0	0	-	85	17	0	0
041-060	0	0	58	17	0	0	0	67	33	0	-	0	83	83	0
061-080	0	0	0	83	17	0	0	0	67	58	-	0	0	17	58
081-100	0	0	0	0	83	0	0	0	0	42	-	0	0	0	34
101-120	-	-	-	-	-	-	-	-	-	-	-	0	0	0	8
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	75	9	0	0	100	10	0	0	0	95	19	0	0	0
021-040	0	25	55	18	0	0	90	17	0	0	5	81	0	0	0
041-060	0	0	36	55	18	0	0	83	17	0	0	0	100	0	0
061-080	0	0	0	27	55	0	0	0	83	25	0	0	0	100	50
081-100	0	0	0	0	27	0	0	0	0	75	0	0	0	0	50
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	24	0	0	0	100	76	33	0	0					
021-040	0	76	17	8	0	0	24	67	75	41					
041-060	0	0	75	50	8	0	0	0	25	42					
061-080	0	0	8	42	75	0	0	0	0	17					
081-100	0	0	0	0	17	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Thuja occidentalis* 'Lutescens' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	52	8	0	0	100	76	0	0	0	-	30	0	0	0
021-040	0	48	84	25	0	0	24	58	0	0	-	70	100	0	0
041-060	0	0	8	75	42	0	0	42	92	8	-	0	0	100	0
061-080	0	0	0	0	58	0	0	0	8	59	-	0	0	0	100
081-100	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	95	55	9	0	0	95	10	0	0	0	100	30	0	0	0
021-040	5	45	91	73	27	5	90	42	0	0	0	70	67	0	0
041-060	0	0	0	27	73	0	0	58	41	0	0	0	33	92	8
061-080	-	-	-	-	-	0	0	0	59	58	0	0	0	8	92
081-100	-	-	-	-	-	0	0	0	0	42	-	-	-	-	-
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	57	0	0	0	95	76	34	17	8					
021-040	0	43	66	17	0	5	24	66	50	33					
041-060	0	0	34	75	25	0	0	0	33	50					
061-080	0	0	0	8	67	0	0	0	0	9					
081-100	0	0	0	0	8	-	-	-	-	-					

*Dats were collected since 1992.

THUJA OCCIDENTALIS

'MASTERSII'

Family:	Cupressaceae
English name:	Mastersii American Arborvitae
French name:	Thuja occidentalis 'Mastersii'
Category:	Evergreen plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This small shrub of globular habit can grow to 1.5-2.0 m tall and 1.0 m wide. In shape, it is similar to the cultivar 'Wareana'.

The short, rigid and flattened branches are arranged vertically. The upright, loose shoots give the crown, which is slightly conical in shape, a feathery look. The young shoots are sometimes curved at the tips.

The stocky, scale-like leaves give the shrub a coarse appearance. The fairly dense foliage is dark green, and shiny on the undersides. It turns slightly brownish in winter.

Cones have not been observed on the cultivar and growth is moderate.

ORIGIN AND DISTRIBUTION

No information on this cultivar was found in the literature.

USE

Ornamental: This cultivar is used in landscaping as a specimen plant or in mass plantings. It is prized for its unusual shape.

REQUIREMENTS

This shrub prefers full sun, but also tolerates partial shade well. It prefers deep, rich and moist soils. Pruning is unnecessary, as is winter protection.

DISEASES AND INSECTS

Thuja species are potential primary hosts for various types of cedar rusts (*Gymnosporangium juniperi-virginianae*, *Gymnosporangium globosum*), with *Thuja occidentalis* being the most susceptible. Cultivars are probably more resistant to cedar rust than the species form.

Alternaria, *Epicoccum* and collar rot (*Phytophthora* sp., *Sclerotinia* sp., *Pythium* sp.) are other fungal diseases that may occur under favourable conditions.

The main insect pests affecting *Thuja* comprise scale insects (Iecanium and Fletcher scale), spider mites, northern cedar bark beetle (*Phloeosinus canadensis*), black vine weevil (*Otiorhynchus sulcatus*) and strawberry root weevil (*Otiorhynchus ovatus*).

PROPAGATION

Cuttings: Cuttings should be taken in late spring or early summer, treated with an auxin compound and placed under a mist unit. A slightly acid substrate is recommended.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin Roger-Van den Hende, Laval University, Sainte-Foy (Quebec)

Propagation site: Laval University, Sainte-Foy (Quebec)

Propagation technique: On June 26, 1989, 482 cuttings (10 cm) were taken from roughly twenty-year-old parent plants. The cuttings were dipped for five seconds in a 8,000-ppm IBA/50 % ethanol solution and then rinsed with tap water. They were then immersed in a Captan-Benomyl® solution. They were planted in a peat-perlite mixture (2:3; v:v), and placed under a mist unit (Mist-A-Matic®). The rooting rate was 42 % after 77 days. The seedlings were potted up on September 14 in Fertal Pot® in a peat-perlite mixture (3:2; v:v), treated with a soluble fertilizer (20-20-20) and kept in an unheated greenhouse. In mid-November, the seedlings were put in plastic bags

perforated with a hatpin and put in the cold store at 0 °C. In May 1990, 200 seedlings were transplanted to the nursery and grown on until May 1991. They were dug up, puddled, wrapped and kept in the cold store at 4 °C to await shipping.

Inclusion in testing network: Seedlings 12 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Seedlings died after transplanting at almost all the sites: 17 % at L'Assomption and Sainte-Foy; 31 % at Sainte-Clotilde, Deschambault, Saint-Hyacinthe and La Pocatière; 40 % at Normandin and 67 % at Kapuskasing. Transplanting bareroot plants does not seem very successful in this cultivar.

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage occurred at L'Assomption and Sainte-Clotilde.

At Saint-Hyacinthe, 25 % of seedlings had foliage browning the third winter. No other damage occurred.

Region 2

At Sainte-Foy, frost damage to the branch tips was observed the last four winters in 67 %, 8 %, 33 % and 34 % of shrubs.

At Deschambault, one seedling had foliage browning the second and third winters.

No damage occurred at La Pocatière.

Region 3

At Normandin, the first winter, 13 % and 7 % of seedlings suffered frost damage to the branch tips and the previous year's shoots respectively. No damage occurred in subsequent winters.

At Kapuskasing, one shrub died the third winter. Roughly 15 % of shrubs suffered frost damage to the one-year-old shoots the first and third winters. The branch tips were damaged in 43 % of plants the third winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

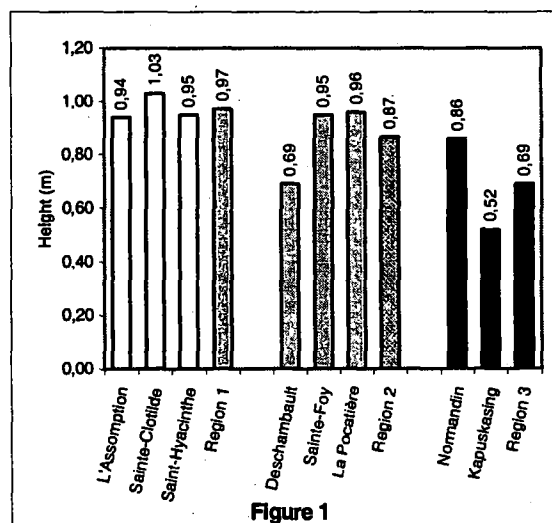


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

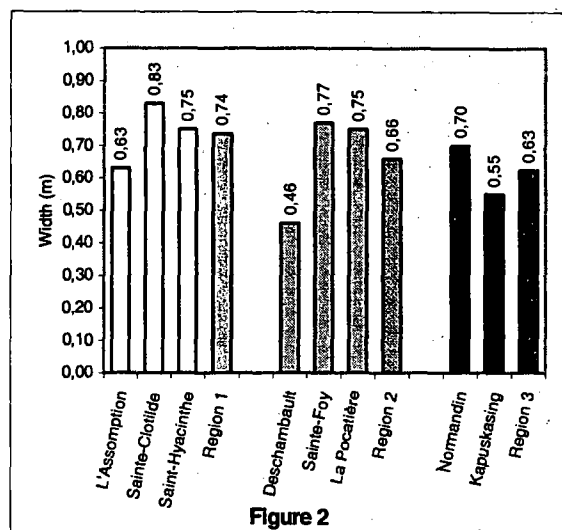


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth was regular at all sites during the trial.

Effect of pruning

No pruning was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After three growing seasons, all the shrubs at Saint-Hyacinthe, Sainte-Foy, La Pocatière and Normandin had reached a height of 40-80 cm. A fourth year was required at L'Assomption and Sainte-Clotilde to obtain plants of comparable height.

This cultivar can be produced at all sites in hardiness zones 2b to 5b.

HARDINESS EVALUATION

The results of the trial show that the cultivar can survive and be used at least as far as zone 2a.

The cultivar achieved its full ornamental potential at the region 1 sites and La Pocatière. The parent plant at the Jardin Roger-Van den Hende has not suffered any damage for a number of years, unlike the young seedlings evaluated at Sainte-Foy.

BIBLIOGRAPHIC REFERENCES

2, 7, 26

WRITTEN BY

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Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Thuja occidentalis* 'Mastersii' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage											Cumulative damage
		WINTER DAMAGE ^a											
	1	2	3	4	5	6	7	8	9	10	11	14	
REGION 1													
L'Assomption	100												0
Sainte-Clotilde	100												0
Saint-Hyacinthe	95											5	5
REGION 2													
Deschambault	97											3	3
Sainte-Foy	72	28											28
La Pocatière	100												0
REGION 3													
Normandin	96	3		1									4
Kapuskasing	84	8		5				3					16

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Thuja occidentalis* 'Mastersii' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	100	33	0	0	100	100	17	0	0	-	57	0	0	0
041-080	0	0	67	67	8	0	0	83	75	8	-	43	100	100	25
081-120	0	0	0	33	92	0	0	0	25	92	-	0	0	0	75
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-040	100	100	50	40	20	100	56	0	0	0	100	81	0	0	0
041-080	0	0	50	60	20	0	44	100	67	0	0	19	100	83	0
081-120	0	0	0	0	60	0	0	0	33	100	0	0	0	17	100
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-040	100	93	0	0	0	100	100	71	33	0					
041-080	0	7	100	82	27	0	0	29	67	100					
081-120	0	0	0	18	73	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Thuja occidentalis* 'Mastersii' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	11	0	0	0	94	44	0	0	0	-	21	0	0	0
021-040	0	89	92	8	0	6	56	59	17	0	-	79	50	0	0
041-060	0	0	8	84	42	0	0	33	58	9	-	0	50	75	8
061-080	0	0	0	8	58	0	0	8	25	45	-	0	0	25	59
081-100	-	-	-	-	-	0	0	0	0	46	-	0	0	0	33
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	56	44	30	30	0	63	11	0	0	0	94	0	0	0	0
021-040	44	56	50	20	30	37	89	17	0	0	6	87	0	0	0
041-060	0	0	20	50	60	0	0	83	58	0	0	13	100	42	0
061-080	0	0	0	0	10	0	0	0	42	75	0	0	0	58	92
081-100	-	-	-	-	-	0	0	0	0	25	0	0	0	0	8
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	53	0	0	0	71	71	0	0	0					
021-040	0	47	73	0	0	29	29	57	33	17					
041-060	0	0	27	82	9	0	0	43	50	50					
061-080	0	0	0	18	91	0	0	0	17	33					
081-100	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

TILIA CORDATA MILL.

Family:	Tiliaceae
English name:	Small-Leaved European Linden
French name:	Tilleul à petites feuilles, tilleul des bois
Category:	Deciduous plant
Subdivision:	Medium-sized tree

BOTANTICAL DESCRIPTION

This tree, which can grow to 15 m tall, is pyramidal in habit when young but becomes conical to ovoid over time. The straight trunk has smooth bark, which becomes reddish and furrowed with age, with many brown branches.

The simple, alternate leaves are roughly 4-8 cm in diameter. They are small and cordate, rounded at the base and sharply acuminate at the tip. The blade has irregularly toothed margins. The leaves are a shiny dark green above and glaucous beneath, turning a lovely yellow in fall.

The yellowish flowers are dense and fragrant, occurring in cymes of 3-7 flowers. They are attached to a narrow, lanceolate bract measuring 4-8 mm long. They bloom in July and August.

The fruits hard, smooth, thin-walled capsules that are ovoid in shape are of little interest and mature in fall.

The creeping roots sucker easily.

ORIGIN AND DISTRIBUTION

This species has been cultivated for a long time and is native to all of Europe, from the Atlantic to the Urals and north to Scandinavia. It grows in both upland and lowland areas of France, except for the Mediterranean region. It was introduced in North America by the early colonists.

USE

Ornamental: Prized for its foliage and flowers, this species is used in mass plantings or as a specimen tree in large areas. It is also very useful as a roadside tree.

Edibility: The flowers and bracts are used in herbal teas.

Cabinet work: The soft, white, homogenous wood is used for wood sculpture.

Cooking: Bees are especially attracted by the flowers.

REQUIREMENTS

This species prefers full sun, but tolerates light shade well. It grows in any type of soil but prefers a fertile, deep, well-drained, slightly calcareous soil. It does not withstand prolonged drought very well, but takes well to pruning and is easily trained when young. It tolerates urban pollution, but is very susceptible to damage from road salt.

DISEASES AND INSECTS

This species is susceptible to coral spot as well as powdery mildew (*Microsphaera penicillata*). Aphids are attracted to the species. In severe infestations, these insects produce large quantities of honeydew, which favours the development of sooty moulds and dirties everything underneath the tree. The linden borer (*Saperda vestita*), red spider mites and Japanese beetles (*Popillia japonica*) also attack the species. Some plants at Sainte-Clotilde were infested with the linden borer.

PROPAGATION

Seeds: According to some horticulturists, the seeds will germinate immediately if the fruits are harvested in fall just when they are beginning to change colour. Under natural conditions, the dry, mature fruits take two seasons to germinate. Some authors recommend a 20-minute sulphuric acid bath, followed by washing and stratification for three to five months in moist peat moss at 1-5 °C. This treatment is required because the pericarp is impermeable

to water and the embryo is immature. Once stratified, the seeds will germinate immediately.

Grafting: Grafting is used to propagate cultivars.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Lawyer Nurseries, Colorado (United States)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds were received in fall 1987 and were sown in a cold frame on November 4. They were planted 10 mm deep in a Promix®-sand mixture (1:2; v:v). The seedlings began to emerge on May 10, 1988. On May 23, 1989, the seedlings were transplanted to the nursery. In mid-October, 200 seedlings were dug up, puddled and heeled in for the winter. The survival rate was 100 %. On May 23, 1990, 183 seedlings were retransplanted back to the nursery. On October 23, they were dug up, puddled and heeled in until the spring of 1991; the winter survival rate was 100 %. On April 18, they were wrapped and put in the cold store at 4 °C to await shipping in May.

Inclusion in testing network: Seedlings 50-60 cm high and 55 mm in trunk diameter were planted at eight test sites throughout Quebec and northeastern Ontario (Table 1). Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage was found at L'Assomption and Saint-Hyacinthe.

At Sainte-Clotilde, 10 % and 26 % of the seedlings died the first two winters.

Region 2

At Sainte-Foy, frost damage to the branch tips was observed in the first, third and fourth winters in 5 %, 8 % and 50 % of the trees.

At Deschambault, the same type of damage was found in 5 % and 8 % of the trees the second and fourth winters.

At La Pocatière, branch tip damage was found in 25 %, 15 % and 8 % of the seedlings the first three winters. In addition, 8 % of trees suffered damage to the one-year-old shoots the third winter.

Region 3

At Normandin, two seedlings died the first winter. Frost damage to the branch tips was found after the first and third winters in 5 % and 42 % of seedlings. Damage to the one-year-old shoots was found the second winter in 6 % of plants.

At Kapuskasing, frost damage to the branch tips was seen at the end of each of the first three winters in 19 %, 43 % and 25 % of seedlings. Damage to the one-year-old shoots was observed the second and third winters in 10 % and 75 % of trees.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the plants after five years at each site in the three regions.

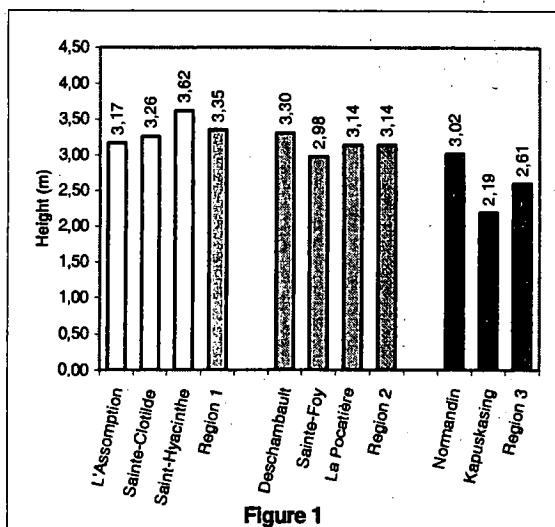


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

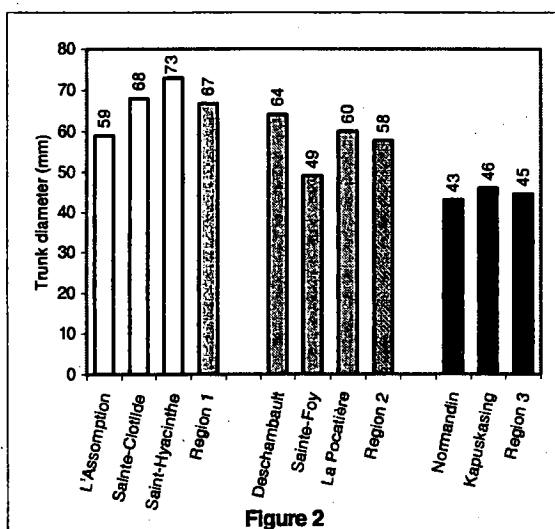


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning, other than training, was required.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will

find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

After four growing seasons, almost all the trees had grown to over 2 m tall, except at Kapuskasing. Most of the trees at Saint-Hyacinthe and La Pocatière reached a diameter of over 40 mm after three years. At L'Assomption, Sainte-Clotilde, Deschambault and Sainte-Foy, the same diameter was only attained after four years.

This species can be easily produced in regions 1 and 2.

HARDINESS EVALUATION

According to the literature, the species is hardy to zone 3. The results of these tests show that the species can survive as far as zone 2a without much damage.

In addition, the species can be used as far as zone 2b, taking account of the fact that the harshest conditions in terms of damage to the branch tips occurred from the third winter onwards in zone 2.

The species achieved its full ornamental potential during the tests in zone 5.

BIBLIOGRAPHIC REFERENCES

2, 7, 8, 9, 18, 21, 26, 29, 31, 34, 39, 40, 76, 77

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Raynald Drapeau, Agr.

Table 1. Frequency of winter damage observed on *Tilia cordata* Mill. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ³									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	93						7				7
Saint-Hyacinthe*	100										0
REGION 2											
Deschambault	98	2									2
Sainte-Foy	87	13									13
La Pocatière	89	10	1								11
REGION 3											
Normandin	88	9	1				2				12
Kapuskasing	63	17	17						3		37

^a Key :

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period.

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this species.

Table 2. Breakdown of *Tilia cordata* Mill. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	85	5	0	0	0	95	52	0	0	0	-	5	0	0	0
101-200	15	90	50	0	0	5	48	54	18	0	-	86	25	0	0
201-300	0	5	50	83	42	0	0	36	55	36	-	9	75	41	8
301-400	0	0	0	17	48	0	0	10	27	46	-	0	0	59	84
401-500	0	0	0	0	10	0	0	0	0	18	-	0	0	0	8
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	72	10	0	0	0	72	0	0	0	0	85	30	8	8	8
101-200	28	86	33	8	0	28	91	33	8	0	15	60	33	0	0
201-300	0	4	67	75	8	0	9	67	84	67	0	10	59	42	16
301-400	0	0	0	17	83	0	0	0	8	33	0	0	0	50	76
401-500	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-100	60	0	0	0	0	90	48	0	0	0					
101-200	40	100	58	16	8	10	52	100	67	25					
201-300	0	0	42	84	25	0	0	0	33	75					
301-400	0	0	0	0	67	-	-	-	-	-					
401-500	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Tilia cordata* Mill. plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	85	15	0	0	0	57	32	0	0	0	-	-	0	0	0
021-040	15	80	59	17	17	43	68	45	9	0	-	-	0	0	0
041-060	0	5	41	83	42	0	0	55	63	27	-	-	58	33	16
061-080	0	0	0	0	41	0	0	0	28	55	-	-	42	67	34
081-100	-	-	-	-	-	0	0	0	0	18	-	-	0	0	50
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	14	0	0	0	86	14	0	0	0	90	40	0	0	0
021-040	0	86	42	8	0	14	86	75	17	17	10	60	84	25	8
041-060	0	0	58	83	34	0	0	25	83	83	0	0	16	67	25
061-080	0	0	0	9	66	-	-	-	-	-	0	0	0	8	67
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	100	83	8	0	0	85	71	33	0	0					
021-040	0	17	92	91	41	15	29	67	92	25					
041-060	0	0	0	9	59	0	0	0	8	75					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1993.

TILIA CORDATA

'GREENSPIRE'

Family:	Tiliaceae
English name:	Greenspire Linden
French name:	Tilleul 'Greenspire'
Category:	Deciduous plant
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This broad, ovoid tree of symmetrical habit can grow to 25 m tall and 10 m wide.

The smooth, greyish-brown bark becomes fissured with age. The trunk is very straight, with the main branches vertical and the secondary branches spreading. The twigs are smooth and sturdy, and often zigzagged.

There are no terminal buds and the lateral buds are large, pointed, asymmetrical and covered with two or three scales. The leaf scars are prominent, with 5-10 vein scars.

The simple, alternate leaves are cordate but asymmetric at the base and have acuminate tips. They are thick and shiny, with prominent teeth. The petiole is nearly as long as half the length of the blade. The lateral veins are straight and extend to the leaf margins. The foliage, dark green in summer, turns yellowish brown in fall.

The yellowish, highly fragrant flowers appear in late June. Each flower has five petals and five sepals. The small inflorescences loose, hanging cymes are borne on stalks originating in the leaf axils of the new shoots.

The fruits, small capsules, are not of great ornamental interest.

The tree is deep rooted and does not do well in poorly drained soil.

ORIGIN AND DISTRIBUTION

The species is native to Europe. This cultivar is the result of a selection of *Tilia cordata* 'Euclid' x 'Boston' (a selection developed at Boston Park, United States).

USE

Ornamental: This tree, which provides plentiful shade, can be used as a specimen plant in landscaping. It requires little maintenance and is of great ornamental value as a street tree, but does not tolerate road salt.

REQUIREMENTS

Like all *Tilia*, this cultivar prefers sun, but tolerates shade well. It prefers a deep, moist, fertile, well-drained soil that is slightly calcareous. It is highly resistant to pollution but becomes deformed if exposed to road salt.

DISEASES AND INSECTS

The species and all its cultivars are highly susceptible to the linden borer (*Saperda vestita*). Although Japanese beetles (*Popillia japonica*) also attack the genus, there is no specific information on the cultivar. Powdery mildew (*Microsphaera penicillata*) may also be a problem in the genus.

PROPAGATION

Grafting: Shield budding done in summer is very successful.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: City of Montreal Nursery, Terrebonne (Quebec)

Rootstock: Lawyer Nurseries, Colorado (United States)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption, Quebec

Propagation technique: The rootstocks (three-year-old seedlings) were roughly 20 mm in diameter (size of a

pencil). The scions were taken on August 21, 1990 from parent plants at the Terrebonne nursery measuring 4 m tall and 100 mm in diameter. Shield budding was done on August 23 on 350 subjects; the survival rate was 78 % the following spring. The rootstocks were cut back on May 10, 1991 to 1 cm from the graft union. The scions were staked and tied during the growing season. On October 15, the young trees were dug up and heeled in for the winter. On April 22, 1992, they were wrapped and put in a cellar to await shipping.

Inclusion in testing network: Seedlings 1.39 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

No damage occurred at L'Assomption.

At Sainte-Clotilde, two trees died the third winter and single plants died the last two winters.

At Saint-Hyacinthe, a seedling died the first winter.

Region 2

At Sainte-Foy, the branch tips were damaged in 10 % of seedlings the second winter and in almost all plants the third winter. The last winter, 67 % of plants suffered damage from mechanical breakage.

At Deschambault, 10 % of seedlings suffered frost damage to the branch tips the second winter.

Frost damage occurred only during the first winter at La Pocatière, with 5 % of the seedlings suffering damage to their branch tips and 5 %, to the one-year-old shoots.

Region 3

At Normandin, one seedling died the first winter. Frost damage to the branch tips occurred in 33 % and 5 % of trees the first two winters and one plant suffered mechanical breakage the last winter.

At Kapuskasing, one seedling died the first winter. Frost damage to the branch tips occurred in 25 %, 34 % and 17 % of trees the first, third and fourth winters. The second winter, one tree had frost damage to the one-year-old shoots.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the plants after five years at each site in the three regions.

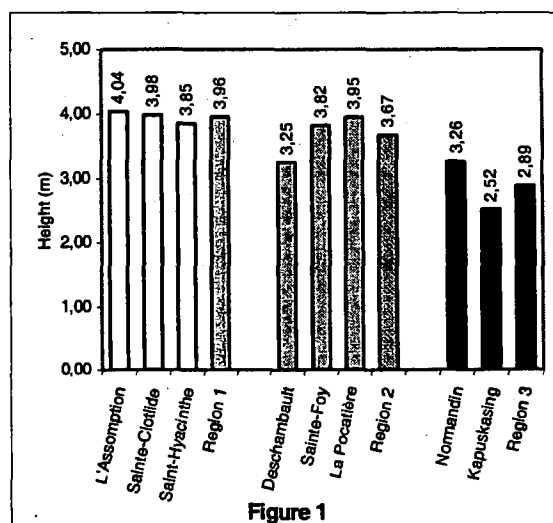


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

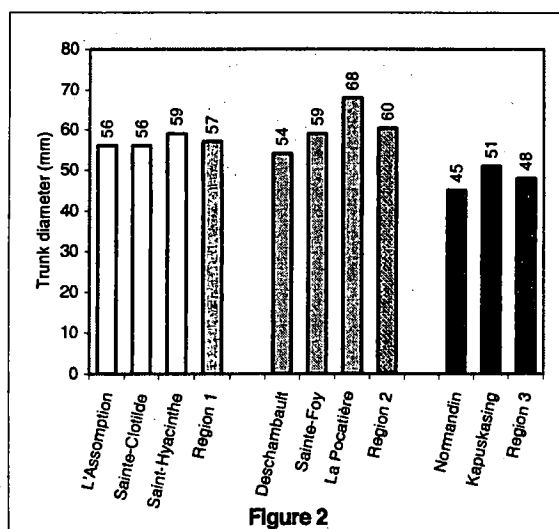


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Growth was vigorous and regular at all sites during the trial, although a little slower at Kapuskasing.

Effect of pruning

Only training was done.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

After three growing seasons, 92 % of the trees at La Pocatière were over 3 m tall. A fourth year was required at L'Assomption and Sainte-Foy to obtain trees of a comparable height (75 % and 83 % of trees) and a fifth year was required at Deschambault. At Sainte-Clotilde and Saint-Hyacinthe, measurements were not taken the last year, so the growth rate could not be calculated for this period.

The cultivar can be produced at sites in zones 4 and 5 as well as in the colder regions, although annual growth will be slower in the latter.

HARDINESS EVALUATION

According to the literature, the cultivar, like the species, is hardy to zone 3. The test results show that the cultivar can survive as far as zone 2, since the young plants (5 years) did not suffer any mortality.

The cultivar can be used in zones 2 to 5 and achieves its full ornamental potential in zone 4.

BIBLIOGRAPHIC REFERENCES

3, 7, 18, 39, 41

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Table 1. Frequency of winter damage observed on *Tilia cordata* 'Greenspire' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		1	2	4	5	6	7	8	9	10	
REGION 1											
L'Assomption	100										0
Sainte-Clotilde	92							8			8
Saint-Hyacinthe	99							1			1
REGION 2											
Deschambault	98		2								2
Sainte-Foy	66		21							13	34
La Pocatière	98		1	1							2
REGION 3											
Normandin	90		7					1		2	10
Kapuskasing	83		15	1				1			17

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | 14 = partial browning of the foliage |

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Tilia cordata* 'Greenspire' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	0	0	0	0	0	0	0	0	0	-	5	5	0	0	-
101-200	100	29	0	0	0	100	34	0	0	-	95	80	75	0	-
201-300	0	71	50	25	0	0	66	60	35	-	0	15	25	58	-
301-400	0	0	50	75	25	0	0	40	65	-	0	0	0	42	-
401-500	0	0	0	0	75	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101-200	100	19	0	0	0	90	34	0	0	0	100	30	0	0	0
201-300	0	81	100	67	25	10	66	75	17	0	0	70	8	0	0
301-400	0	0	0	33	75	0	0	25	83	67	0	0	92	100	58
401-500	-	-	-	-	-	0	0	0	0	33	0	0	0	0	42
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-100	0	5	8	8	0	0	0	0	0	0					
101-200	100	85	75	8	8	100	100	42	0	0					
201-300	0	10	17	50	25	0	0	58	100	100					
301-400	0	0	0	34	59	-	-	-	-	-					
401-500	0	0	0	0	8	-	-	-	-	-					

*Data were collected until 1995.

Table 3. Breakdown of *Tilia cordata* 'Greenspire' plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	19	0	0	0	0	29	0	0	0	-	62	5	0	0	-
021-040	81	100	83	8	0	71	100	87	5	-	38	95	8	8	-
041-060	0	0	17	92	67	0	0	13	95	-	0	0	92	92	-
061-080	0	0	0	0	33	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	43	0	0	0	0	48	5	0	0	0	15	0	0	0	0
021-040	57	100	75	25	0	52	95	58	17	0	85	100	0	0	0
041-060	0	0	25	75	83	0	0	42	83	58	0	0	100	100	8
061-080	0	0	0	0	17	0	0	0	0	42	0	0	0	0	92
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	48	50	8	8	8	5	0	0	0	0					
021-040	52	50	83	75	17	95	100	83	8	0					
041-060	0	0	9	17	58	0	0	17	92	92					
061-080	0	0	0	0	17	0	0	0	0	8					

*Data were collected until 1995.

TILIA X

'FLAVESCENS GLENLEVEN'

Family:	Tiliaceae
English name:	Glenleven Linden
French name:	Tilleul 'Glenleven'
Subdivision:	Deciduous plant
Category:	Large tree

BOTANICAL DESCRIPTION

This tree can reach a height of 15 m and a spread of 7 m at maturity. Of symmetrical, conical habit, it grows broader with age.

The very straight trunk, covered with thick, fibrous, reddish bark, supports a strong central leader bearing the semi-erect branches.

The stout twigs are smooth and zigzagged.

The large, pointed, asymmetrical buds are enclosed in two or three scales. They occur in two rows along the shoot. The terminal bud is usually aborted. The prominent leaf scars have 5-10 vein scars.

The dark green, heart-shaped leaves turn yellow in fall. They are simple, alternate, and prominently toothed, acuminate at the apex and asymmetrical at the base. The length of the petiole is nearly half that of the blade. The lateral veins are straight and extend to the leaf margins.

The small, yellowish-white flowers are fragrant and appear in June. Each has five petals and five sepals. The small inflorescences loose, hanging cymes are borne on stalks originating at the leaf axils of the new shoots.

The grey, pubescent fruits are not of great interest.

The shallow, creeping roots sucker easily.

ORIGIN AND DISTRIBUTION

Tilia x 'Flavescens Glenleven' originated from a cross between *Tilia cordata* and *Tilia americana*.

USE

Ornamental: This excellent street tree requires little care. It can also be used as a specimen plant in small gardens or in mass plantings in large spaces.

REQUIREMENTS

This tree prefers full sun and a deep, fertile, moist, well-drained soil that is slightly calcareous. It should not be planted in dry soils. Pruning is generally unnecessary, except to train the young tree.

DISEASES AND INSECTS

Aphids are attracted to lindens and this cultivar is no exception. In severe infestations, these insects produce large quantities of honeydew, which favours the development of sooty moulds and dirties everything underneath the tree.

PROPAGATION

Cuttings: Semiripe cuttings are taken before the terminal buds have formed (before the stems lignify). Hormone treatments are recommended and not much foliage has to be removed to get the cutting to root well.

Grafting: Shield budding, which is done in August, has a high success rate. The cultivar is usually grafted onto a *Tilia cordata* rootstock.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Scion : City of Montreal Nursery, Terrebonne (Quebec)

Rootstock : Seeds from Lawyer Nurseries, Colorado (USA)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The rootstocks were three-year-old seedlings with a trunk diameter the thickness of a pencil. The scions were taken on August 21, 1990 from parent plants at the Terrebonne nursery, which measured 4 m tall and 12 cm in diameter. Grafting (shield budding) was carried out on August 22 using 350 subjects; the survival rate the following spring was 90 %. The rootstocks were cut back on May 10, 1991 to 1 cm from the graft union. The scions were staked and tied during the growing season. On October 15, the seedlings were dug up and heeled in for the winter. On April 22, 1992, they were wrapped and put in a cellar to await shipping.

Inclusion in testing network: Young seedlings roughly 1.3 m high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

The most frequently observed winter damage was frost injury to the branch tips.

Region 1

At L'Assomption, one seedling died the first winter, but no other winter damage occurred.

At Sainte-Clotilde, one plant died the second winter and another suffered frost damage to the branch tips the first winter.

At Saint-Hyacinthe, the one-year-old shoots were damaged on two seedlings the first winter. The second winter, three seedlings suffered frost damage to the branch tips.

Region 2

At Sainte-Foy, 28 %, 100 % and 33 % of trees suffered frost damage to the branch tips the second, third and fourth winters. Mechanical breakage occurred in over half the plants the last winter.

The only damage at Deschambault was frost damage to the branch tips, which affected 5 %, 20 % and 8 % of trees during the first three winters.

At La Pocatière, the first winter, one seedling had damage to the one-year-old shoots. Frost damage to the branch tips was observed in 25 % and 10 % of seedlings the first two winters.

Region 3

At Normandin, one tree died during each of the second and fifth winters. The first two winters, 33 % and 62 % of seedlings had frost damage to the branch tips. The first winter, 15 % of seedlings suffered frost damage to the one-year-old shoots. Mechanical breakage occurred in one plant the last winter.

At Kapuskasing, frost damage to the branch tips occurred the first four winters in 95 %, 33 %, 58 % and 8 % of trees. The one-year-old shoots were affected in 25 % of trees the third winter.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the plants after five years at each site in the three regions.

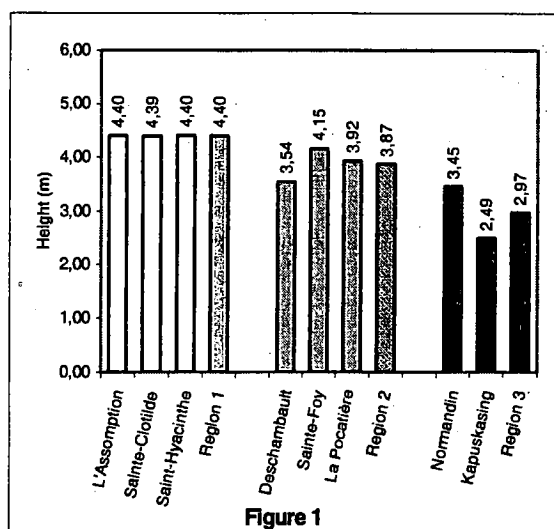


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

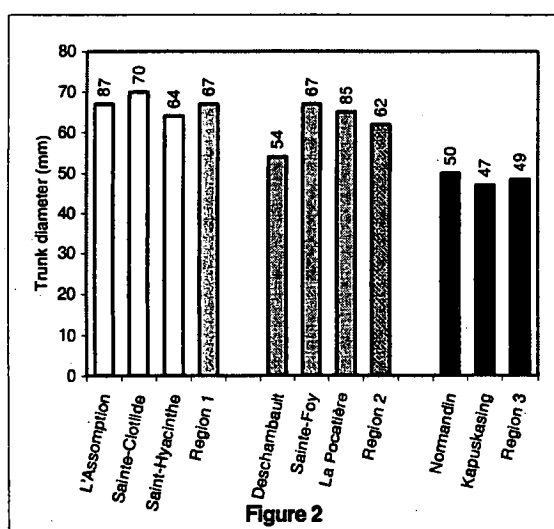


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

The outstanding results at Saint-Hyacinthe increased the regional mean. Trunk diameters were particularly homogenous at the region 2 and 3 sites.

Effect of pruning

Only training was done during the five years of the trial.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

To obtain trees over 2 m tall, three growing seasons were required at L'Assomption, Sainte-Clotilde, Deschambault, Sainte-Foy and La Pocatière. A fourth year was required at Saint-Hyacinthe and Normandin and a fifth year at Kapuskasing.

In terms of trunk diameter, trees at the region 1 sites had diameters of 41 mm after four growing seasons. In region 3, a comparable diameter was not attained during the trial.

The cultivar can be easily produced at region 1 and 2 sites.

HARDINESS EVALUATION

According to the literature, this cultivar is hardy to zone 5 (USDA system). The trial results show that the cultivar will survive at a young age as far as zone 2a. Since damage was light at all sites, the cultivar can be used as far as zone 2a.

The young trees reached their full ornamental potential at the region 1 sites. The cultivar also grows very well in region 2.

BIBLIOGRAPHIC REFERENCES

3, 7, 18, 39, 41

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Tilia* x 'Flavescens Glenleven' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	99						1				1
Sainte-Clotilde	98	1					1				2
Saint-Hyacinthe	93	5	2								7
REGION 2											
Deschambault	94	6									6
Sainte-Foy	56	32							12		44
La Pocatière	92	7	1								8
REGION 3											
Normandin	74	19	3				2		2		26
Kapuskasing	58	39	3								42

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6, 7, 9 and 11 occurred for this cultivar.

Table 2. Breakdown of *Tilia x 'Flavescens Glenleven'* plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	0	0	0	0	0	0	0	0	0	-	0	5	0	0	-
101-200	100	50	0	8	0	100	49	0	0	-	100	66	73	0	-
201-300	0	50	67	8	0	0	51	60	0	-	0	29	15	0	-
301-400	0	0	33	67	8	0	0	40	74	-	0	0	12	92	-
401-500	0	0	0	17	92	0	0	0	26	-	0	0	0	8	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101-200	100	24	0	0	0	95	19	0	0	0	100	48	0	0	0
201-300	0	76	100	83	0	5	81	33	8	0	0	52	83	25	0
301-400	0	0	0	17	92	0	0	67	84	25	0	0	17	75	42
401-500	0	0	0	0	8	0	0	0	8	75	0	0	0	0	58
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-100	0	0	0	0	0	0	0	0	0	0					
101-200	100	75	33	0	0	100	100	67	17	0					
201-300	0	25	58	50	0	0	0	33	83	92					
301-400	0	0	9	50	91	0	0	0	0	8					
401-500	0	0	0	0	9	-	-	-	-	-					

*Data were collected until 1995.

Table 3. Breakdown of *Tilia x 'Flavescens Glenleven'* plants by marketable trunk diameter category from 1992 to 1996

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde*					Saint-Hyacinthe*				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	29	0	0	0	0	24	0	0	0	-	67	5	0	0	-
021-040	71	100	42	0	0	76	100	55	0	-	33	90	75	0	-
041-060	0	0	58	92	25	0	0	45	93	-	0	5	25	83	-
061-080	0	0	0	8	75	0	0	0	7	-	0	0	0	17	-
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	33	0	0	0	0	33	0	0	0	0	33	0	0	0	0
021-040	67	100	67	8	0	67	100	8	0	0	67	100	33	0	0
041-060	0	0	33	92	92	0	0	92	92	8	0	0	67	100	17
061-080	0	0	0	0	8	0	0	0	8	92	0	0	0	0	83
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	24	15	0	0	0	24	5	0	0	0					
021-040	76	85	75	50	18	76	95	100	50	17					
041-060	0	0	25	42	55	0	0	0	50	83					
061-080	0	0	0	8	27	-	-	-	-	-					

*Datan were collected until 1995.

TILIA JAPONICA (MIQ.) SIMONKAI

Family:	Tiliaceae
English name:	Japanese Linden
French name:	Tilleul japonais
Category:	Deciduous plant
Subdivision:	Large tree

BOTANICAL DESCRIPTION

This tree, very symmetrical and conical in shape, greatly resembles *Tilia cordata*. It may reach a height of 25 m.

The reddish bark becomes furrowed with age.

The simple, alternate leaves are rounded, sharply acuminate at the apex and cordate at the base.

The highly fragrant flowers bloom in June. The peduncle is joined to the centre of the bract, which resembles a leaf.

ORIGIN AND DISTRIBUTION

In North America, this species, which is relatively unknown, is found exclusively in botanical collections.

USE

Ornamental: Prized for its foliage and flowers, the species can be used as a specimen plant or in mass plantings in large spaces. It is also very useful as a street tree in an urban setting.

Bee pasturage: In Russia, this species accounts for 75 % of the honey production obtained from the genus.

REQUIREMENTS

The species does best in full sun but tolerates light shade well. Little information is available on this rare species.

DISEASES AND INSECTS

The species does not seem to be troubled by aphids; unlike *Tilia cordata*. A few seedlings were attacked by the linden borer (*Saperda vestita*) at Sainte-Clotilde.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden Arboretum, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal, Quebec (Quebec)

Propagation technique: The seeds were harvested on September 5 from a 36-year-old parent plant measuring 18 m tall and 12 m wide. On October 9, 1986, 600 seeds were sown 5 mm deep in a cold frame. In June 1988, 240 seedlings were potted up and planted in beds, where they overwintered. The winter survival rate was 100 %. In May 1989, they were transplanted to the nursery, where growth was slow. The winter survival rate was under 70 %. In fall 1990, the seedlings were dug up, puddled and heeled in to await shipping in the spring of 1991.

Inclusion in testing network: Seedlings 55 cm high and 5 mm in trunk diameter were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

At L'Assomption, 25 % of seedlings died shortly after transplanting.

Region 1

At L'Assomption, 33 % of the seedlings died during the fourth winter. Frost damage to the branch tips occurred in 38 %, 23 % and 8 % of trees the first three winters. Damage to the one-year-old shoots was observed in 31 % and 8 % of the trees the second and fourth winters. The third winter, 75 % of seedlings had frost damage to the old wood. The first winter, 8 % of seedlings had frost damage down to the snow cover.

At Sainte-Clotilde, one seedling died the first winter and two others died the second winter. A single seedling suffered frost damage to the one-year-old shoots the second winter. No other damage was observed.

At Saint-Hyacinthe, no damage occurred.

Region 2

At Sainte-Foy, frost damage to the branch tips was found in 58 %, 25 %, 33 % and 17 % of seedlings the first four winters. Damage to the one-year-old shoots was found in one tree during each of the first and third winters. Frost damage to the old wood occurred in a single seedling the second winter.

At Deschambault, frost damage to the branch tips occurred in 33 %, 33 %, 42 % and 8 % of trees the first four winters. Frost damage to the one-year-old shoots occurred the first three winters in 8 %, 42 % and 8 % of trees.

At La Pocatière, frost damage to the branch tips was observed during the first four winters, affecting 31 %, 46 %, 25 % and 25 % of trees. During the same period, 15 %, 23 %, 25 % and 17 % of trees had frost damage to the one-year-old shoots.

Region 3

At Normandin, a single seedling died the second winter. Damage to the branch tips was observed the first four winters, affecting 58 %, 33 %, 36 % and 9 % of seedlings respectively. Frost damage to the one-year-old shoots

occurred in single seedlings the second and fourth winters. In addition, two trees froze down to the level of the snow cover the third winter.

At Kapuskasing, frost damage to the branch tips occurred every winter, affecting 63 %, 44 %, 9 %, 73 % and 64 % of plants. Frost damage to the one-year-old shoots was observed the first three winters in 6 %, 31 % and 91 % of trees.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the plants after five years at each site in the three regions.

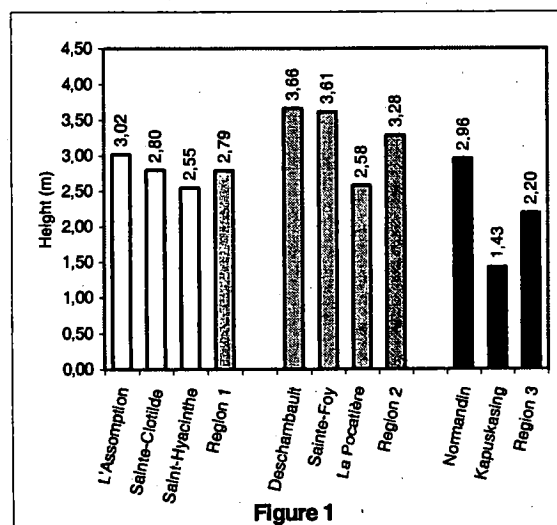


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

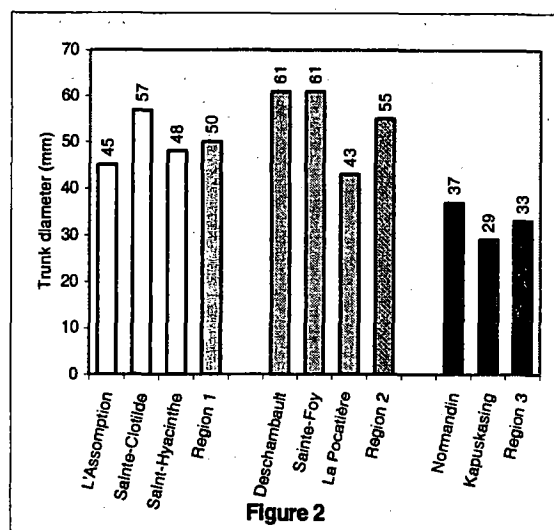


Figure 2

Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Effect of pruning

No pruning, other than training, was required in the species.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and trunk diameter.

This species, which is not well known and difficult to find, seems to lend itself to production in zones 2b to 5, with the proviso that trunk diameter growth was greater at the region 1 and 2 sites.

HARDINESS EVALUATION

This rare species, propagated from a parent plant in the Montreal Botanical Garden, has proven viable as far as zone 2b. The results of the tests show that it can survive as far as zone 2a, although growth will be very slow.

The species' full ornamental potential was achieved during the trial in zone 5 at Saint-Hyacinthe (zone 5b) and Sainte-Clotilde (5a).

BIBLIOGRAPHIC REFERENCES

2, 7

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Tilia japonica* (Miq.) Simonkai from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE*									
	1	2	4	5	6	7	8	9	10	11	
REGION 1											
L'Assomption	55	14	8	15	1		7				45
Sainte-Clotilde	93		2				5				7
Saint-Hyacinthe*	100										0
REGION 2											
Deschambault	65	23	12								35
Sainte-Foy	68	27	3	2							32
La Pocatière	59	25	16								41
REGION 3											
Normandin	65	27	3		3		2				35
Kapuskasing	24	50	26								76

* Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period.

No damage of type 3, 7, 9, 10 and 11 occurred for this species.

Table 2. Breakdown of *Tilia japonica* (Miq.) Simonkai plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	38	23	0	17	0	69	42	0	0	0	-	16	0	0	0
101-200	62	46	25	50	13	31	58	57	29	0	-	84	91	50	8
201-300	0	31	67	25	25	0	0	43	57	71	-	0	9	50	75
301-400	0	0	8	8	50	0	0	0	14	29	-	0	0	0	17
401-500	0	0	0	0	12	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	17	0	0	0	0	17	0	0	0	0	85	17	17	0	0
101-200	83	41	8	8	0	83	59	0	0	0	15	83	75	25	25
201-300	0	59	84	42	8	0	41	83	50	0	0	0	8	67	58
301-400	0	0	8	50	92	0	0	17	42	83	0	0	0	8	17
401-500	-	-	-	-	-	0	0	0	8	17	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-100	25	8	0	0	0	94	94	41	55	18					
101-200	75	84	55	27	0	6	6	59	45	72					
201-300	0	8	45	64	45	0	0	0	0	10					
301-400	0	0	0	9	55	-	-	-	-	-					
401-500	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Table 3. Breakdown of *Tilia japonica* (Miq.) Simonkai plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	31	0	0	0	77	42	0	0	0	-	-	8	0	0
021-040	0	69	67	67	38	23	58	43	43	0	-	-	92	50	25
041-060	0	0	33	33	50	0	0	57	57	72	-	-	0	50	58
061-080	0	0	0	0	12	0	0	0	0	14	-	-	0	0	17
081-100	-	-	-	-	-	0	0	0	0	14	-	-	-	-	-
Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	83	8	0	0	0	92	25	0	0	0	100	67	17	0	0
021-040	17	84	58	8	8	8	75	33	8	8	0	33	83	75	33
041-060	0	8	42	84	42	0	0	67	75	33	0	0	0	25	67
061-080	0	0	0	8	50	0	0	0	17	59	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trunk diameter (mm)	REGION 3														
	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	92	67	27	0	0	94	87	75	45	0					
021-040	8	33	73	90	64	6	13	25	55	90					
041-060	0	0	0	10	36	0	0	0	0	10					
061-080	-	-	-	-	-	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1993.

ULMUS RUBRA MUHLENB.

Family:	Ulmaceae
English name:	Slippery Elm, Red Elm
French name:	Orme rouge
Category:	Deciduous plant
Subdivision:	Medium-sized tree

BOTANICAL DESCRIPTION

This tree, which resembles the White Elm, can grow to 25 m tall, 18 m wide and over 50 cm in trunk diameter.

The branches, which are ascending or spreading, begin higher up on the trunk than in the White Elm, resulting in a longer bole. The crown is flat on the top and rounded on the sides.

The reddish-brown bark is shallowly furrowed with irregular, vertical and scaly ridges.

The stout, greyish-brown, pubescent twigs are ascending or spreading, unlike those of the White Elm, which are descending. The new shoots are orangish red and the buds are dark brown and obtuse, covered with reddish-brown hairs at the tips.

The simple, alternate leaves are oblique or asymmetrical at the base, with stipules that quickly dry up and are shed. They are dark green on the upper surface, with very stiff hairs that make the dried leaves abrasive. The underside is paler and pubescent. The leaves are roughly 12 cm long and 7 cm wide.

The flowers occur in dense glomerules and bloom in spring. They are borne on the previous year's twigs on very short peduncles and are inconspicuous in colour (reddish or yellowish).

The fruits are flat, orbicular samaras, the seedcase surrounded by a thin, membranous wing notched at the top. The samaras turn reddish brown when ripe and fall to the ground in late June.

The shallow but wide-spreading roots anchor the tree well.

ORIGIN AND DISTRIBUTION

The species is native to North America. In Canada, its range comprises the deciduous forest region and the southern part of the Great Lakes-St. Lawrence forest region. It grows in association with other hardwoods, including maples, walnuts and ash. It occurs as far south as Florida and Texas.

USE

Ornamental: This species can be used in landscaping large areas.

Cabinet work: The wood, like that of the White Elm, is used to make boxes, packing cases, furniture, wood panels and barrels for dry stores. It is also used in shipbuilding.

Edibility: The bark, when chewed, assuages thirst.

REQUIREMENTS

The species grows best in rich soils along streams and at the base of slopes. It is sometimes found on dry, rocky ridges.

DISEASES AND INSECTS

Opinions are divided on whether the species is affected by Dutch elm disease. However, the disease occurred in three seedlings at Sainte-Clotilde and one at La Pocatière during the trial.

PROPAGATION

Seeds: The seeds are only viable for short periods. Sowing is generally done as soon as the seeds mature, with germination occurring shortly afterward.

Cuttings: Semiripe cuttings taken in June and treated with an auxin compound give good results. The species can also be propagated from root cuttings and bud cuttings with a leaf.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, La Pocatière (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The seeds were harvested in June 1989. As soon as they were received, they were sown (June 28) 10 mm deep in a Promix® sand mixture (1:2; v:v) in a cold frame shaded with a cloth (63 %). Emergence occurred on July 14 of the same year. In spring 1990, the seedlings were thinned and, beginning in June, treated weekly with a soluble fertilizer (20-20-20). The winter survival rate was 100 %. The seedlings were dug up on October 23, puddled and heeled in for the winter. On April 17, 1991, they were wrapped and put in the cold store at 4 °C to await shipping in May.

Inclusion in testing network: Seedlings 10-15 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Damage was observed at all the sites. At Kapuskasing, damage to the one-year-old shoots was observed in 64 % of seedlings every year. At the other sites, this damage occurred mainly the first three winters.

Region 1

At L'Assomption, the third winter, one tree died and another suffered frost damage to the old wood. Frost damage to the branch tips occurred in 60 % of plants the second and third winters.

At Saint-Clotilde, two trees died the first, second and fourth winters. The third winter, 72 % of seedlings had frost damage to the branch tips.

At Saint-Hyacinthe, one seedling died the first winter. Frost damage to the branch tips occurred in 30 % and 8 % of trees the first and third winters.

Region 2

At Sainte-Foy, frost damage to the branch tips occurred the first four winters in 67 %, 19 %, 58 % and 33 % of trees. Damage to the one-year-old shoots was observed the second and third winters in 28 % and 17 % of plants.

At Deschambault, frost damage to the branch tips was observed each winter in 48 %, 33 %, 50 %, 25 % and 17 % of trees. Damage to the one-year-old shoots occurred the first three winters in 5 %, 19 % and 25 % of seedlings.

At La Pocatière, one tree died the fourth winter. Frost damage to the branch tips occurred the first three winters in 95 %, 19 % and 25 % of plants. Damage to the one-year-old shoots was observed the second and third winters in 62 % and 25 % of trees.

Region 3

At Normandin, one tree died the third winter. Frost damage to the branch tips occurred after the fourth winter in 27 % of trees. After the first two winters, 76 % and 100 % of plants had frost damage to the one-year-old shoots. Four plants had frost damage down to the snow cover during the third winter. Mechanical breakage linked to climatic conditions was observed in 20 % of trees the first, third and fourth winters.

At Kapuskasing, frost damage to the one-year-old shoots occurred all five winters, affecting 70 %, 100 %, 83 %, 25 % and 42 % of trees respectively. Frost damage to the branch tips was observed the first, fourth and fifth winters in 20 %, 75 % and 42 % of trees. The third winter, 17 % of plants froze down to the ground level.

Height and trunk diameter growth

Figures 1 and 2 show the mean height and trunk diameter of the plants after five years at each site in the three regions.

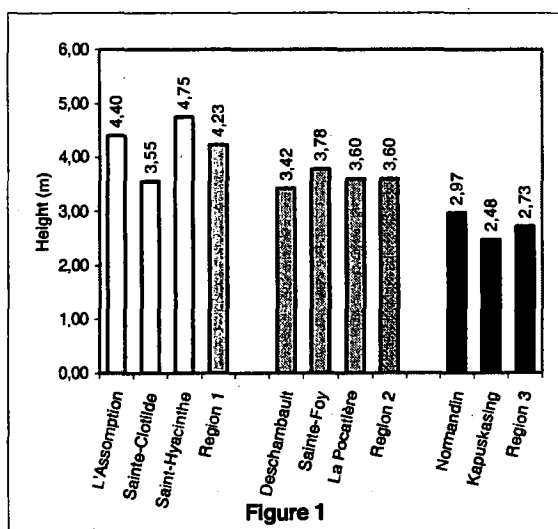


Figure 1. Mean height of trees at trial's end at each of the eight sites and three regions

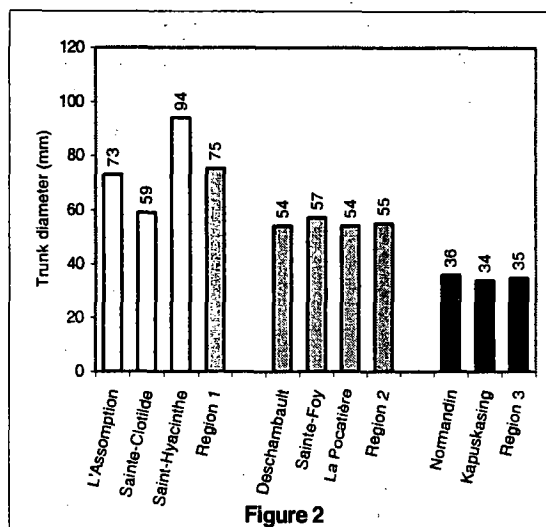


Figure 2. Mean trunk diameter of trees at trial's end at each of the eight sites and three regions

Height growth was variable from region to region as well as among sites in the same region. Significant height growth was recorded during the second and third growing seasons at L'Assomption and Deschambault, while at Sainte-Clotilde, height growth increased up to the third growing season and then fell off. At Saint-Hyacinthe, annual growth decreased progressively beginning with the second growing season. Height growth exceeded 1 m at Sainte-Foy and La Pocatière during the second, third and fourth growing seasons. At Normandin, growth was 1 m or more every year, except for the third growing season, while at Kapuskasing, growth was over 1 m beginning with the third growing season.

Effect of pruning

The only type of pruning required was training.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and trunk diameter categories (heights and diameters are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production

and the number of years needed to obtain a given height and trunk diameter.

Most plants reached a height of over 2 m after three growing seasons at all region 1 and 2 sites. Two additional years, however, were required to obtain trees of comparable height at the two other sites. Since less frost damage occurred in region 1, production should probably be limited to that region.

HARDINESS EVALUATION

The severity of winter damage increased from region 1 to region 3, ranging from light damage in region 1 to damage to the previous year's shoots in region 3. The species can survive as far as zone 2a, but can only be used as far as zones 4a or 3b.

Full ornamental potential was not attained in the trials, even though the seedlings came from a tree perfectly adapted to zone 4a climatic conditions. The winter damage that occurred may be due to the fact that the seedlings were fertilized, leading to a longer growth period than would occur in a natural environment.

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2, 4, 7, 8, 9, 26, 28, 31, 32, 39, 77

WRITTEN BY

Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Ulmus rubra* Muhlenb. from 1992 to 1996

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE*									
		1	2	4	5	6	7	8	9	10	
REGION 1											
L'Assomption	65	25	6	2			2				35
Sainte-Clotilde	76	15	1				8				24
Saint-Hyacinthe*	91	8					1				9
REGION 2											
Deschambault	52	34	10	2					2		48
Sainte-Foy	56	35	9								44
La Pocatière	51	28	17	2			2				49
REGION 3											
Normandin	37	5	35		7		2		14		63
Kapuskasing	5	28	64			3					95

* Key:

- 1 = no damage
 2 = damage to the tip of the previous year's shoot
 3 = frost damage on the flower buds
 4 = previous year's shoot affected
 5 = old wood affected
 6 = dead down to the level of snow cover

- 7 = dead down to the ground surface
 8 = dead
 9 = sunscald, trunk spitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

*Damage was evaluated over a four-year period.

No damage of type 3, 9 and 11 occurred for this species.

Table 2. Breakdown of *Ulmus rubra* Muhlenb. plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	74	0	0	0	0	74	18	9	0	0	-	0	0	0	0
101-200	26	21	0	0	0	26	53	18	18	22	-	42	0	0	0
201-300	0	74	67	18	0	0	18	27	27	11	-	53	33	17	0
301-400	0	5	33	46	36	0	11	28	28	45	-	5	58	42	33
401-500	0	0	0	36	36	0	0	18	18	0	-	0	9	25	17
501-600	0	0	0	0	28	0	0	0	9	11	-	0	0	16	50
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-100	81	5	0	0	0	86	5	0	0	0	100	0	0	0	0
101-200	19	57	0	9	0	14	47	16	0	0	0	48	0	0	0
201-300	0	33	67	50	33	0	48	42	25	8	0	52	92	33	18
301-400	0	5	33	33	58	0	0	42	75	50	0	0	8	67	55
401-500	0	0	0	8	0	0	0	0	0	42	0	0	0	0	27
501-600	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-100	41	0	0	0	0	75	25	8	0	0					
101-200	59	35	50	55	0	25	75	25	100	9					
201-300	0	65	42	36	55	0	0	67	0	83					
301-400	0	0	8	0	45	0	0	0	0	8					
401-500	0	0	0	9	0	-	-	-	-	-					
501-600	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

Table 3. Breakdown of *Ulmus rubra* Muhlenb. plants by marketable trunk diameter category from 1991 to 1995

Trunk diameter (mm)	REGION 1														
	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	0	0	0	0	100	18	18	0	0	-	-	0	0	0
021-040	0	100	17	9	0	0	82	27	28	33	-	-	0	0	0
041-060	0	0	83	55	18	0	0	46	36	11	-	-	83	8	0
061-080	0	0	0	36	64	0	0	9	27	34	-	-	17	50	17
081-100	0	0	0	0	18	0	0	0	9	11	-	-	0	42	58
101-120	-	-	-	-	-	0	0	0	0	11	-	-	0	0	25

Trunk diameter (mm)	REGION 2														
	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	100	33	0	0	10	100	43	0	0	0	100	86	0	0	0
021-040	0	67	67	33	17	0	57	50	8	0	0	14	100	33	0
041-060	0	0	33	59	50	0	0	50	75	75	0	0	0	67	73
061-080	0	0	0	8	23	0	0	0	17	25	0	0	0	0	27
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Trunk diameter (mm)	REGION 3									
	Normandin					Kapuskasing				
	91	92	93	94	95	91	92	93	94	95
001-020	100	94	33	27	0	100	100	58	25	0
021-040	0	6	67	55	82	0	0	42	75	83
041-060	0	0	0	18	18	0	0	0	0	17
061-080	-	-	-	-	-	-	-	-	-	-
081-100	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-

*Datan were collected since 1993.

WEIGELA FLORIDA

'NANA PURPUREA'

Family:	Caprifoliaceae
English name:	Nana Purpurea Weigela
French name:	Weigela 'Nana Purpurea'
Synonym:	<i>Weigela florida</i> 'Purpurea Nana'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This dense dwarf shrub, of narrow, compact habit, can grow to over 1 m in height and width.

The branches are erect at first but become slightly drooping with age. The leaves are oval to oblong with an acuminate apex, and are dark purple with a greenish cast.

The dark pink bell-shaped flowers bloom abundantly in May and June from two-year-old wood and a second flowering occurs later from the current year's young shoots.

The fine roots are very numerous.

ORIGIN AND DISTRIBUTION

The species is native to Japan, northern China, Korea and Manchuria, and was introduced in 1845. No references were found for this cultivar.

USE

Ornamental: The cultivar can be used alone or in association with other plants. It is prized for its summer flowering, the colour of its foliage and its dwarf form.

REQUIREMENTS

This cultivar prefers full sun but will also tolerate light shade. In the shade, however, its floral characteristics and

habit will be less attractive. It is not demanding about soil, but does best in a well-drained site.

The cultivar transplants well. Pruning, when required, should be done after the first flowering. Pruning involves removing the branches that have already flowered to make way for the new shoots that will bear the next crop of flowers.

DISEASES AND INSECTS

In general, plants of this genus are resistant to disease. No major diseases seem to affect this cultivar.

Two flea beetles often cause significant damage in the genus: the western black flea beetle (*Phyllotreta pusilla*) and the redheaded flea beetle (*Systema frontalis*).

PROPAGATION

Cuttings: Hardwood cuttings taken in fall, or semiripe cuttings taken in June after flowering, and placed under a mist unit root readily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden Arboretum, Montreal (Quebec)

Propagation site: Montreal Botanical Garden, Montreal (Quebec)

Propagation technique: 320 cuttings (15 cm long) were taken on July 3 and 4, 1991 from three-year-old parent plants measuring 40 cm tall and 30 cm wide. They were dipped in a 4,000-ppm IBA/50 % ethanol solution. The seedlings were planted in a plug tray filled with a perlite-Promix® mixture (1:1; v:v), and placed under a mist unit operating for 30 seconds every 7 minutes. The rooting rate was 95 %. Once rooted, the cuttings were planted in shaded beds on August 15. They were potted up on August 26 in Fertil Pot®. They overwintered in a glass cold frame, and then were wrapped and shipped on May 5, 1992.

Inclusion in testing network: Seedlings 6-12 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Some seedlings died shortly after transplanting at Sainte-Foy and Normandin (35 % and 25 % of seedlings respectively).

Region 1

At L'Assomption, the only damage observed was frost injury to the branch tips, seen in 67 %, 67 %, 92 % and 100 % of shrubs the first two and last two winters.

At Sainte-Clotilde, rodent damage was found in three seedlings at the end of the first winter. The branch tips were damaged in 19 %, 33 % and 34 % of shrubs during the first two winters and the last winter.

At Saint-Hyacinthe, one shrub died during each of the first and third winters and two others died the fourth winter. Frost damage to the branch tips occurred in 25 % and 92 % of plants the second and third winters. The second winter, one seedling suffered frost damage down to the ground level and 44 % of seedlings had damage to the one-year-old shoots.

Region 2

At Sainte-Foy, 31 %, 100 %, 20 % and 90 % of plants suffered frost damage to the branch tips the first four winters. In addition, 10 % of shrubs were damaged by the weight of the snow the last winter.

At Deschambault, 10 %, 17 % and 25 % of shrubs had frost damage to the branch tips the second, third and fifth winters. The last winter, 67 % of shrubs suffered mechanical breakage.

At La Pocatière, one shrub died the fourth winter. The first winter, one seedling froze right down to the ground level and all seedlings had damage to the branch tips the second winter.

Region 3

At Normandin, 18 %, 67 % and 40 % of seedlings died the first three winters, leaving only three shrubs to be evaluated. In addition, the first winter, 82 % of seedlings froze down to the ground level. Frost damage to the branch tips was observed in 33 % and 100 % of shrubs after the second and fourth winters. In addition, all shrubs had damage to the one-year-old wood in the last winter.

At Kapuskasing, only six seedlings survived the first winter; of these, two died the fourth winter. The surviving shrubs had frost damage to the entire aerial portion or to the one-year-old shoots all five winters.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

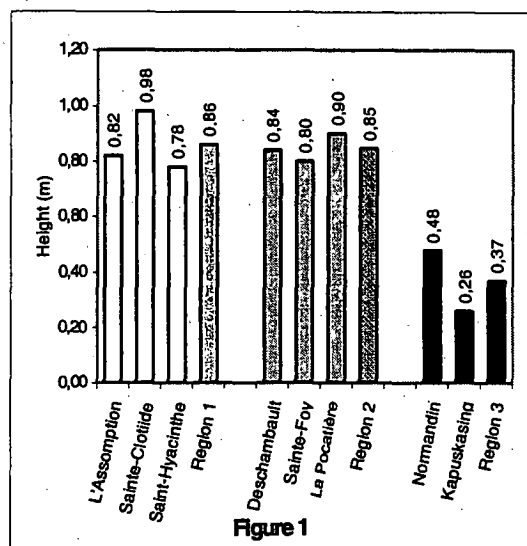


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

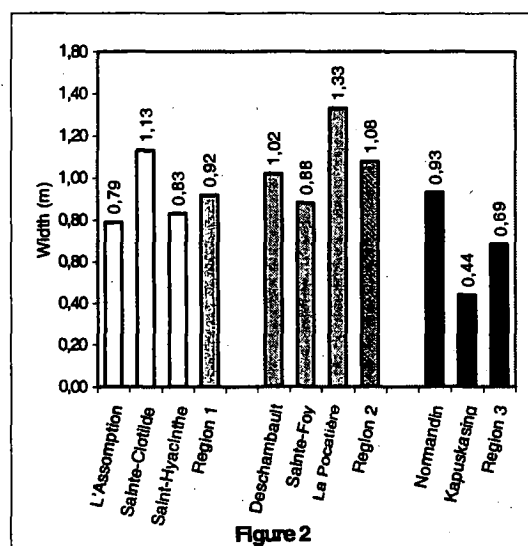


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Height growth was particularly homogenous in regions 1 and 2. Growth was regular and increased every year at all sites except Normandin and Kapuskasing, where growth was slow. At Kapuskasing, no gains in height growth were made beginning in the second year.

Effect of pruning

Only light pruning was needed at most sites, except Normandin and Kapuskasing, where close to half of the branches had to be cut back.

Flowering

The cultivar flowered every year at all region 1 and 2 sites but flowering was much rarer at the two region 3 sites. Flowering began between May 23 and June 9 at Saint-Hyacinthe and in the first week of June at the other sites. Severe cold in winter delayed the onset of flowering until around June 30. The duration of flowering was 13-32 days, depending on the year. At all region 2 sites, the first flowers appeared around June 10 the first few years and around June 5 the last few years; the duration of flowering was 15-33 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Two growing seasons were required to obtain seedlings over 41 cm wide at Deschambault, Sainte-Foy and La Pocatière, while three seasons were needed at Sainte-Clotilde, four at Normandin and five at L'Assomption.

Plants can be produced fastest in region 2; despite the snow cover, the mortality was too great in region 3 to make production efficient. The same is true of region 1, where the snow cover was likely to disappear during the coldest winter periods.

HARDINESS EVALUATION

According to the literature, the cultivar is hardy to zones 4 or 5. The results of the trial show that, while the cultivar

can survive as far as zone 4, mortality is too great in zone 2 and the plants will gradually die off.

The cultivar can be used as far as zone 4a, with the proviso that the spring pruning required will reduce the abundance of flowers produced during the first flowering.

The cultivar's full ornamental potential was not achieved at the test sites and can only be attained outside of the zones tested.

BIBLIOGRAPHIC REFERENCES

3, 7, 9, 18, 21, 33, 35, 76

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Weigela florida* 'Nana Purpurea' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		1	2	3	4	5	6	7	8	10	
REGION 1											
L'Assomption	35	65									65
Sainte-Clotilde	80	17								3	20
Saint-Hyacinthe	60	23		9			2	6			40
REGION 2											
Deschambault	76	10						1	13		24
Sainte-Foy	50	48							2		50
La Pocatière	77	20					1	2			23
REGION 3											
Normandin	12	27		20			16	25			88
Kapuskasing	0	5		16			57	22			100

- ^aKey:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6 and 9 occurred for this cultivar.

Table 2. Breakdown of *Weigela florida* 'Nana Purpurea' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	24	0	0	0	0	5	0	0	0	0	5	0	0	0	0
021-040	71	10	8	25	0	95	10	0	0	0	70	35	18	18	11
041-060	5	90	33	25	8	0	90	0	0	8	20	15	36	9	0
061-080	0	0	59	50	50	0	0	10	0	0	0	45	46	55	44
081-100	0	0	0	0	17	0	0	90	100	42	5	5	0	18	45
101-120	0	0	0	0	25	0	0	0	0	50	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	20	0	0	0	0	-	-	-	-	-	5	0	0	0	0
021-040	75	0	0	0	0	77	0	0	0	0	95	0	0	0	0
041-060	5	90	50	8	8	23	70	30	10	10	0	33	0	0	0
061-080	0	10	50	67	42	0	30	70	60	50	0	67	33	0	0
081-100	0	0	0	25	33	0	0	0	30	40	0	0	67	100	73
101-120	0	0	0	0	17	-	-	-	-	-	0	0	0	0	27
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-020	69	25	0	0	0	76	0	33	17	0					
021-040	31	0	100	0	0	24	100	67	83	100					
041-060	0	75	0	33	67	-	-	-	-	-					
061-080	0	0	0	67	33	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Weigela florida* 'Nana Purpurea' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	57	17	17	0	100	10	0	0	0	100	55	18	18	0
041-080	0	43	83	75	58	0	90	15	0	8	0	45	82	45	22
081-120	0	0	0	8	42	0	0	85	24	67	0	0	0	37	78
121-160	-	-	-	-	-	0	0	0	76	25	-	-	-	-	-
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	10	0	0	0	92	8	0	0	0	100	0	0	0	0
041-080	0	90	83	50	17	8	46	90	10	30	0	100	0	0	0
081-120	0	0	17	50	75	0	46	10	90	70	0	0	100	58	18
121-160	0	0	0	0	8	-	-	-	-	-	0	0	0	42	64
161-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	18
REGION 3															
Width (cm)	Normandin					Kapusking									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	100	75	0	0	100	100	100	33	25					
041-080	0	0	25	33	0	0	0	0	67	75					
081-120	0	0	0	67	100	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					
161-200	-	-	-	-	-	-	-	-	-	-					

WEIGELA 'JAVA RED'

Family:	Caprifoliaceae
English name:	Java Red Weigela
French name:	Weigela 'Java Red'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This shrub of rounded habit can reach a height and spread of nearly 1.5 m.

The spreading branches become arched with age, and have two rows of hairs. The pubescent leaves are dark green, with purplish margins, and turn a bronzy purplish colour in fall. The leaves are oval in shape with acuminate tips. They are wide and short (4.0-4.5 cm long).

The purplish-pink, bell-shaped flowers bloom abundantly in June from the two-year-old wood. Recurrent flowering occurs from the new shoots.

The roots are fine and very numerous.

ORIGIN AND DISTRIBUTION

No information on the cultivar's origins was found in the literature.

USE

Ornamental: This cultivar can be used in mass plantings or informal hedges.

REQUIREMENTS

This cultivar prefers full sun but will also tolerate light shade. In the shade, however, its floral characteristics and habit will be less attractive. It is not demanding about soil, but does best in a well-drained situation.

The cultivar transplants well. Pruning, when required, should be done after the first flowering. Pruning involves removing the branches that have already flowered to make

way for the new shoots that will bear the next crop of flowers.

DISEASES AND INSECTS

In general, members of this genus are resistant to disease. No major diseases seem to affect this cultivar. Two flea beetles often cause significant damage in the genus: the western black flea beetle (*Phyllotreta pusilla*) and the redheaded flea beetle (*Systema frontalis*).

PROPAGATION

Cuttings: Hardwood cuttings taken in fall, or semiripe cuttings taken in June after flowering, and placed under a mist unit root readily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Dominique Savio, Saint-Jean-Baptiste-de-Rouville (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (5 cm long) were taken on July 25, 1990 from two-year-old parent plants measuring 35 cm tall and wide. They were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. The seedlings were planted in plug trays containing a Promix®-sand medium (1:2; v:v), and placed under a mist unit (Mist-A-Matic®). The temperature of the heating cables was set at 25 °C. A weekly fungicide treatment (Benomyl®) was provided throughout the propagation period. The rooting rate was 85 % after five weeks. Misting was discontinued and the seedlings were fertilized with a 10-52-10 solution at the recommended rate. On August 2, the seedlings were potted up and fertilized a second time. They received three applications of a soluble fertilizer (20-20-20), and were put in the cold store at 4 °C for fall. Due to premature bud break, the seedlings were brought back into the greenhouse on March 13, 1991. On May 22, they were transplanted to the nursery. In fall, they were dug up,

puddled and heeled in for the winter. On April 26, 1992, they were wrapped and put in the cold store to await shipping in May.

Inclusion in testing network: Seedlings 25 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, frost damage to the branch tips was found in 100 %, 65 %, 92 % and 67 % of plants the first two and last two winters. The second winter, 35 % of seedlings suffered frost damage to the one-year-old shoots. One shrub had damage to the old wood the fourth winter. In addition, 33 % of shrubs suffered rodent damage the last winter.

At Sainte-Clotilde, one seedling died the first winter. Frost damage to the branch tips occurred in 71 % and 33 % of plants the first and third winters. In addition, 5 % and 65 % of seedlings suffered damage to the one-year-old shoots the first two winters.

At Saint-Hyacinthe, 17 % of seedlings suffered frost damage to the branch tips the second winter.

Region 2

At Sainte-Foy, 90 %, 100 %, 25 % and 100 % of shrubs suffered frost damage to the branch tips the first four winters.

At Deschambault, 33 % and 19 % of seedlings suffered damage to the branch tips the first two winters. In

addition, all shrubs suffered mechanical breakage the last winter.

At La Pocatière, 71 % and 100 % of seedlings had frost damage to the branch tips the first two winters. Subsequently, the only damage that occurred was mechanical breakage to 33 % of the shrubs the third winter.

Region 3

At Normandin, 67 % of seedlings had frost damage to the entire aerial portion the first winter. The second and fourth winters, 100 % and 33 % of shrubs respectively had frost damage to the branch tips. All shrubs were damaged by the weight of the snow the last winter.

Single seedlings died the first two winters in Kapuskasing. Damage to the entire aerial portion was observed in shrubs every winter, affecting 57 %, 95 %, 9 %, 18 % and 10 % of them respectively. The one-year-old shoots were affected in 38 %, 82 % and 91 % of shrubs the first and last two winters. The third winter, 91 % of plants suffered frost damage to the branch tips.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

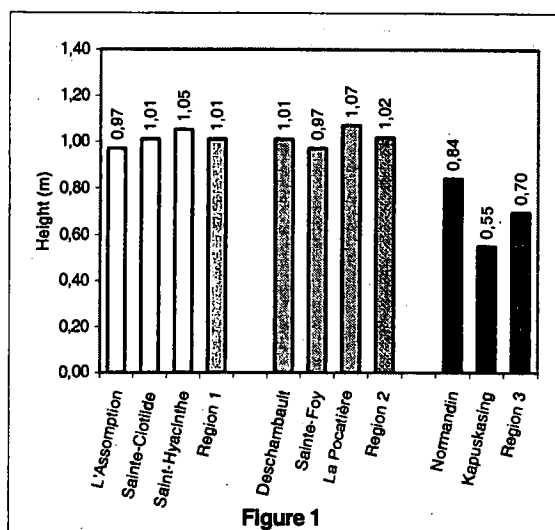


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

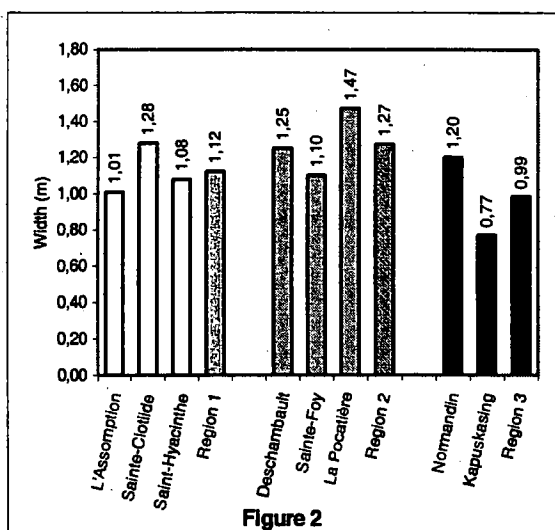


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Height growth was particularly homogenous in regions 1 and 2. In region 3 (Normandin and Kapuskasing), height growth did not increase from the third growing season onwards.

Width was greater than height by the second year at all sites, except L'Assomption and Saint-Hyacinthe.

Effect of pruning

Extensive pruning had to be done at Normandin and Kapuskasing every year.

Flowering

The cultivar flowered every year at all the sites in the three regions. At the region 1 sites, the first flowers appeared in the first week of June, and a few days earlier at Saint-Hyacinthe. The duration of flowering was 26-42 days depending on the year. In the Quebec City area, the first flowers appeared 7-12 days later, between June 5 and June 17, and flowering lasted 13-59 days. In region 3, the first flowers appeared sometime between July 14 and July 20. The duration of flowering was 36-45 days at Normandin and 18-77 days at Kapuskasing. It should be noted that only a few plants flowered at the latter site. The first flowering was characterized by an abundance of flowers; recurrent flowering involved much fewer flowers over a longer period.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After two growing seasons, all plants at all sites except Kapuskasing had reached a height of over 41 cm. After four growing seasons, over 80 % of the shrubs at the three region 1 sites and Deschambault had reached a height over 81 cm.

Compared to *Weigela* 'Red Prince', this cultivar had less winter damage and required less pruning in spring. The cultivar can be produced at region 1 and 2 sites and Normandin.

HARDINESS EVALUATION

The species is considered to be hardy to zone 4. The trial results show that it can survive as far as zone 2a, given adequate snow cover. It is slightly more cold adapted than the 'Red Prince' and 'Samba' cultivars.

It can also be used as far as zone 2a. It should be noted that spring pruning reduced the abundance of flowers during the first flowering at all sites.

The cultivar achieved its full ornamental potential at Saint-Hyacinthe (zone 5a).

BIBLIOGRAPHIC REFERENCES

3, 7, 18, 21, 76

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Weigela* 'Java Red' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	5	6	7	8	10	11	3	
REGION 1											
L'Assomption	20	66	8						6		80
Sainte-Clotilde	62	21	16				1				38
Saint-Hyacinthe	97	3									3
REGION 2											
Deschambault	70	10						20			30
Sainte-Foy	37	63									63
La Pocatière	59	34						7			41
REGION 3											
Normandin	40	27				13		20			60
Kapuskasing	0	18	42			38	2				100

^aKey:

- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3, 5, 6 and 9 occurred for this cultivar.

Table 2. Breakdown of *Weigela* 'Java Red' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	20	0	0	0	0	25	0	0	0	0	20	0	0	0	0
041-080	80	100	92	17	25	75	80	91	8	8	80	77	84	8	8
081-120	0	0	8	83	67	0	20	9	92	84	0	23	16	84	92
121-160	0	0	0	0	8	0	0	0	0	8	0	0	0	8	0
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	38	0	0	0	0	10	0	0	0	0	10	0	0	0	0
041-080	62	95	92	8	8	90	67	33	33	34	90	53	33	42	0
081-120	0	5	8	92	92	0	33	67	50	58	0	47	67	58	92
121-160	-	-	-	-	-	0	0	0	17	8	0	0	0	0	8
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	24	0	0	0	0	86	65	55	18	18					
041-080	76	100	100	33	8	14	35	45	82	82					
081-120	0	0	0	67	92	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Weigela* 'Java Red' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	40	10	0	0	0	85	0	0	0	0	80	0	0	0	0
041-080	60	90	83	42	8	15	50	0	8	0	20	85	42	0	0
081-120	0	0	17	58	83	0	50	100	75	33	0	15	58	92	75
121-160	0	0	0	0	9	0	0	0	17	67	0	0	0	8	25
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	24	0	0	0	0	19	5	0	0	0	38	0	0	0	0
041-080	76	34	0	0	0	81	24	8	8	8	62	24	0	0	0
081-120	0	66	100	83	33	0	66	92	8	50	0	76	67	33	0
121-160	0	0	0	17	67	0	5	0	84	42	0	0	33	67	100
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-040	67	5	0	0	0	100	15	0	0	9					
041-080	28	81	75	8	0	0	85	73	64	27					
081-120	5	14	25	92	67	0	0	27	36	64					
121-160	0	0	0	0	33	-	-	-	-	-					

WEIGELA X 'MINUET'

Family:	Caprifoliaceae
English name:	Minuet Weigela
French name:	Weigela 'Minuet'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This dwarf shrub, of compact habit, can grow to 70 cm high and wide in Ottawa. Under our conditions, however, the maximum height and width attained after five years were 55 cm and 90 cm respectively.

The numerous young shoots are thin and erect. They range from brownish grey to dark grey in colour.

The green foliage has light bronze highlights, and turns reddish brown in fall. The young leaves are purple. The leaves are simple and opposite, wide and elliptic to oval in shape. They are acuminate at the apex and rounded at the base, and slightly petiolulate. The leaves appear in late spring.

The small, pink to purple flowers have a light fragrance. They are borne on the previous year's shoots and occur in groups of three, four or five. The flowers are very numerous in June during the first flowering and flowering continues for a long period. The calyx consists of five narrow lobes, while the corolla is two-lipped and infundibuliform. The flowers have five stamens, with a protruding style.

This is a slow-growing shrub.

ORIGIN AND DISTRIBUTION

This cultivar was introduced on the market in 1981 by the Ottawa Research Station. It was bred by Ms. Felicitas Svejda, hybridizer at Agriculture and Agri-Food Canada. It is the result of a cross between two cultivars of *Weigela florida*, *Purpurea* and *Dropmore Pink*. It has been evaluated

since 1974 in Ottawa (under the code K03) and since 1979 in eight locations across Canada.

USE

Ornamental: This *Weigela* can be used in mass plantings or in rock gardens. The species is prized mainly for its flowers, although the series developed by Ms. Svejda also has very attractive foliage in terms of its colour. The cultivar was selected based on flower shape and colour and the colour and abundance of the foliage.

REQUIREMENTS

Like the species form, this *Weigela* prefers full sun but can also adapt to semi-shaded locations. It grows well in a number of different soil types but dislikes too much moisture or an overly calcareous soil.

In the event of frost damage or mechanical breakage, an annual pruning or the cutting back of old branches is required.

Pruning is done after flowering.

DISEASES AND INSECTS

This cultivar does not seem to be affected by any serious diseases. In general, *Weigela* are free of parasites and diseases.

PROPAGATION

Cuttings: Softwood cuttings, taken in late June, root fairly well. However, hardwood cuttings can be taken throughout the summer or even late into fall.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Dominique Savio, Saint-Jean-Baptiste (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: The first batch of 350 cuttings was taken on March 9, 1990 and the second batch, on March 30 of the same year, from parent plants forced in the greenhouse and measuring 30 cm tall and wide. The cuttings were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. They were planted in flats filled with a sand (67 %) and perlite (33 %) mixture, and placed under a mist unit operating for 4 seconds every 8 minutes. A fungicide treatment (Benomyl®) was provided throughout the propagation period. The rooting rate was 82 % after three weeks. The seedlings were potted up in Fertil Pot® on April 19 and 25 and treated with a soluble fertilizer (10-52-10). On May 24, 1990 they were transplanted to the nursery. On October 23, they were dug up, puddled and heeled in for the winter; the winter survival rate was 100 %. On April 18, 1991, the seedlings were wrapped, put in plastic bags and put in the cold store at 5°C to await shipping in May.

Inclusion in testing network: Seedlings 15 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1991 to 1996.

RESULTS (1991-96)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Seedlings died at four of the eight test sites.

Region 1

At L'Assomption, all the shrubs suffered frost damage to the branch tips the first two winters and 25 %, the third winter. The last three winters, no damage occurred in 67 %, 100 % and 100 % of shrubs. One shrub died the third winter, although it had only suffered slight damage the previous winters.

At Sainte-Clotilde, no damage occurred the first two winters. The next two winters, 67 % of shrubs suffered frost damage to the branch tips. All the shrubs suffered damage to the aerial portion above the snow cover the last winter.

At Saint-Hyacinthe, three seedlings died during the first two winters. The first and third winters, 10 % and 33 % of the shrubs had light frost damage to the branch tips.

Region 2

Between 90 % and 100 % of shrubs had no damage the first four winters at Deschambault. The last winter, 83 % of the shrubs suffered frost damage to the branch tips and 17 % had frost damage to the previous year's shoots.

At Sainte-Foy, frost damage to the branch tips occurred in 14 % and 25 % of shrubs the second and third winters. Rodent damage was particularly extensive, affecting 42 % and 33 % of shrubs the third and fourth winters respectively.

At La Pocatière, the only damage that occurred was mechanical breakage, which occurred in 33 % of shrubs the fourth winter.

Region 3

At Normandin, one seedling died the first winter and two others, the third winter. Frost damage to the branch tips occurred in almost all the shrubs the first three winters and 50 % of shrubs had broken branches the last winter.

At Kapuskasing, mortality was very high the first three winters, eliminating 67 %, 28 % and 25 % of the shrubs respectively. The remaining viable shrubs had frost damage down to the ground level or to the previous year's shoots every winter.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

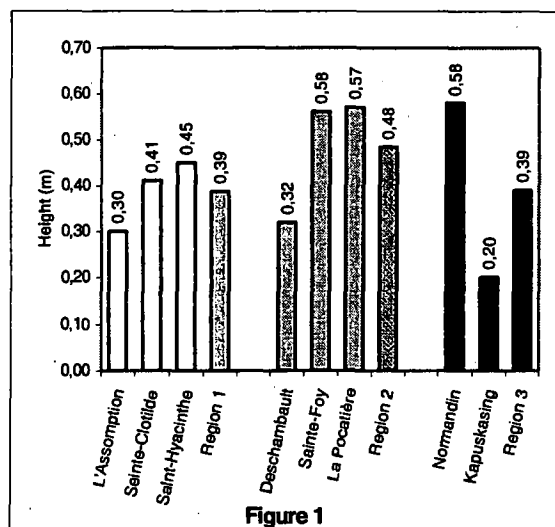


Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

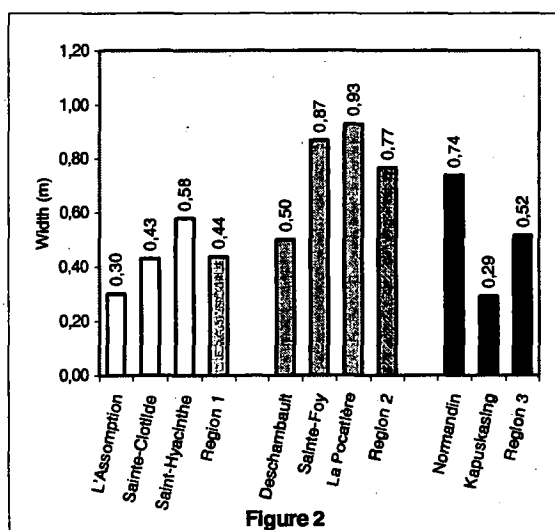


Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth increased annually at the first three sites (Sainte-Foy, La Pocatière and Normandin) and at Sainte-Clotilde. At the other sites, however, the shrubs reached their maximum height at the end of the third growing season. At Kapuskasing, the shrubs had no gains in growth after the first growing season.

Flowering

Flowering lasted around 20-30 days on average in this cultivar, depending on the site and region, although it lasted up to 35-40 days at some sites. In region 1, the first flowers appeared between May 22 and May 30 at Sainte-Clotilde and Saint-Hyacinthe and 4-5 days later at L'Assomption (in general, the earlier flowering begins, the earlier it ends).

At the region 2 sites, plants began flowering between June 3 and June 15, and at Normandin and Kapuskasing, between June 18 and July 6.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

Growth in this cultivar was very rapid the first year at La Pocatière, Deschambault and Normandin, with almost all the plants reaching 20-40 cm tall. After two growing seasons, almost all shrubs, in all regions, were marketable. However, at Kapuskasing, the shrubs were smaller. The tests showed that width growth exceeded height growth.

There seem to be no special climatic conditions beneficial for producing this cultivar, since it grew quickly in all regions tested, except zone 2a.

HARDINESS EVALUATION

The hardiness recommendations given in Agriculture and Agri-Food Canada's fact sheet state that the cultivar was able to withstand the harsh winters in Swift Current, Saskatchewan, and Edmonton, Alberta. However, in this trial, a number of seedlings died in zone 2a, suggesting that the cultivar can survive only as far as zone 2b.

The cultivar can be used as far as zone 2b, where it grew very well in the trial. The occasional mortality that occurred suggests that the snow cover, which provides protection essential to plants' survival, is crucial; if extreme temperatures occur without the presence of an adequate snow cover, plants may die.

This cultivar attracts rodents and special precautions are required.

The cultivar's full ornamental potential can only be achieved in warmer areas than those tested.

BIBLIOGRAPHIC REFERENCES

2, 7, 21, 33, 39, 69

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Weigela* 'Minnet' from 1992 to 1996

Test site	No damage	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
	1	2	4	6	7	8	5 et 9	10	11	
REGION 1										
L'Assomption	53	45				2				47
Sainte-Clotilde	53	27		20						47
Saint-Hyacinthe*	88	9				3				12
REGION 2										
Deschambault	75	22	3							25
Sainte-Foy	77	8							15	23
La Pocatière	93							7		7
REGION 3										
Normandin	30	66				4				70
Kapuskasing	20		18		38	24				80

*Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

*Damage was evaluated over a three-year period.

No damage of type 3, 5 and 9 occurred for this cultivar.

Table 2. Breakdown of *Weigela* 'Minnet' plants by marketable height category from 1991 to 1995

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	33	57	17	9	9	29	5	0	0	0	-	0	0	0	0
021-040	62	43	83	91	91	81	95	75	75	67	-	79	25	50	50
041-060	5	0	0	0	0	0	0	25	25	33	-	21	50	50	50
061-080	-	-	-	-	-	-	-	-	-	-	-	0	17	0	0
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	0	5	0	0	0	14	0	0	0	0	5	0	0	0	0
021-040	100	95	92	100	100	86	67	17	17	0	95	95	8	0	0
041-060	0	0	8	0	0	0	33	75	83	75	0	5	92	42	75
061-080	-	-	-	-	-	0	0	8	0	25	0	0	0	58	25
REGION 3															
Height (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	0	0	0	0	0	29	57	75	100	67					
021-040	100	95	8	40	0	71	43	25	0	33					
041-060	0	5	92	60	100	-	-	-	-	-					
061-080	-	-	-	-	-	-	-	-	-	-					

*Datan were collected since 1992.

Table 3. Breakdown of *Weigela* 'Minnet' plants by marketable width category from 1991 to 1995

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe*				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	53	86	8	18	0	9	5	0	0	0	-	0	0	0	0
021-040	47	14	83	82	100	81	95	50	8	50	-	74	0	0	8
041-060	0	0	9	0	0	10	0	50	75	50	-	26	92	42	50
061-080	-	-	-	-	-	0	0	0	17	0	-	0	8	58	42
081-100	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0
101-120	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	91	92	93	94	95	91	92	93	94	95	91	92	93	94	95
001-020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
021-040	65	55	8	0	0	57	10	8	0	0	95	14	0	0	0
041-060	35	45	92	100	100	43	48	42	42	0	5	86	17	0	0
061-080	-	-	-	-	-	0	42	50	58	25	0	0	67	17	17
081-100	-	-	-	-	-	0	0	0	0	75	0	0	16	67	67
101-120	-	-	-	-	-	-	-	-	-	-	0	0	0	16	16
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	91	92	93	94	95	91	92	93	94	95					
001-020	5	0	0	0	0	33	29	50	33	0					
021-040	75	10	0	0	0	62	71	50	67	100					
041-060	20	37	25	10	10	5	0	0	0	0					
061-080	0	53	67	70	90	-	-	-	-	-					
081-100	0	0	8	20	0	-	-	-	-	-					
101-120	-	-	-	-	-	-	-	-	-	-					

*Data were collected since 1992.

WEIGELA 'RED PRINCE'

Family:	Caprifoliaceae
English name:	Red Prince Weigela
French name:	Weigela 'Red Prince'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

The height potentially reached by this shrub in Quebec has not been determined. Our results show that it can grow to over 1.5 m high and wide after five growing seasons.

It has a wide, erect habit.

The branches are straight when young but become arched with age. The leaves are wide and oval in shape, with an acuminate tip, and are bright green in colour.

The bell-shaped, Chinese red flowers bloom abundantly in early summer from the two-year-old wood; a partial recurrence of flowering occurs in July from the new shoots.

The roots are fine and very numerous.

ORIGIN AND DISTRIBUTION

No information on the cultivar's origins was found in the literature.

USE

Ornamental: The cultivar is used as a specimen plant, in mass plantings, and in informal hedges.

REQUIREMENTS

This cultivar prefers full sun but will also tolerate light shade. In the shade, however, its floral characteristics and habit will be less attractive. It is not demanding about soil, but does best in a well-drained situation.

The cultivar transplants well. Pruning, when required, should be done after the first flowering. Pruning involves

removing the branches that have already flowered to make way for the new shoots that will bear the next crop of flowers.

DISEASES AND INSECTS

In general, members of the genus are resistant to disease. No major diseases seem to affect this cultivar.

Two flea beetles often cause significant damage in the genus: the western black flea beetle (*Phyllotreta pusilla*) and the redheaded flea beetle (*Systema frontalis*).

PROPAGATION

Cuttings: Hardwood cuttings taken in fall, or semiripe cuttings taken in June after flowering, and placed under a mist unit root readily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Pépinière Dominique Savio, Saint-Jean-Baptiste-de-Rouville (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (5 cm long) were taken on July 25, 1990 from two-year-old parent plants measuring 35 cm tall and wide. They were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. The seedlings were planted in plug trays in a Promix®-sand medium (1:2; v:v), and placed under a mist unit (Mist-A-Matic®). The temperature of the heating cables was set at 25 °C. A weekly fungicide treatment (Benomyl®) was provided throughout the propagation period. The rooting rate was 100 % after three weeks. Misting was discontinued and the seedlings were fertilized with a 10-52-10 solution at the recommended rate. On August 2, the seedlings were potted up and fertilized a second time. They later received three applications of soluble fertilizer (20-20-20), and were put in the cold store at 4 °C in the fall. Due to premature bud break, the seedlings were

brought back in the greenhouse on March 13, 1991. On May 22, they were transplanted to the nursery. In fall, they were dug up, puddled and heeled in for the winter. On April 26, 1992, they were wrapped and put in the cold store to await shipping in May.

Inclusion in testing network: Seedlings 25-30 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, frost damage to the branch tips occurred every winter, affecting 100 %, 100 %, 33 %, 92 % and 33 % of plants respectively. In addition, 8 % of shrubs had damage to the old wood during the fourth winter and 67 % of shrubs were damaged by rodents the last winter.

One seedling died the first winter at Sainte-Clotilde. The one-year-old shoots were affected in 11 % and 65 % of seedlings the first two winters. In addition, frost damage to the branch tips occurred in 72 %, 35 %, 33 % and 67 % of shrubs the first four winters.

At Saint-Hyacinthe, one plant died during each of the first and third winters and 54 % of shrubs died the last winter. Frost damage to the branch tips occurred in 100 %, 33 %, 36 % and 45 % of shrubs the last four winters. The third winter, 25 % of shrubs had frost damage to the old wood.

Region 2

At Sainte-Foy, the only damage that occurred was to the branch tips, which affected 100 %, 100 %, 8 % and 92 % of seedlings the first four winters.

At Deschambault, frost damage to the branch tips occurred the first four winters in 33 %, 95 %, 17 % and 8 % of plants. One seedling suffered damage to the one-year-old shoots the second winter and, the following winter, another had damage to the old wood. Rodent damage occurred in 25 % of seedlings the fourth winter and, the following winter, 67 % suffered mechanical breakage.

At La Pocatière, frost damage to the branch tips was observed in 81 %, 100 %, 67 % and 33 % of seedlings the first two and last two winters. Mechanical breakage occurred in 33 % of seedlings the third winter.

Region 3

At Normandin, 33 % of plants suffered damage to the entire aerial portion of the branches the first winter. The second winter, two thirds of the plants suffered frost damage down to the snow cover and the rest had frost damage to the branch tips. No damage occurred the third and fourth winters but the last winter, all plants were damaged by the weight of the snow.

At Kapuskasing, the first two winters, 43 % and 25 % of the seedlings died and the other plants froze right down to the ground level. In the last three winters, 20 %, 100 % and 100 % of the five remaining plants had frost damage to the one-year-old shoots.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

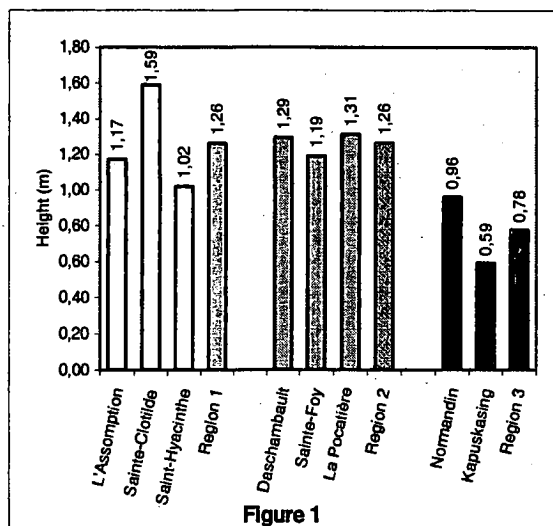


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

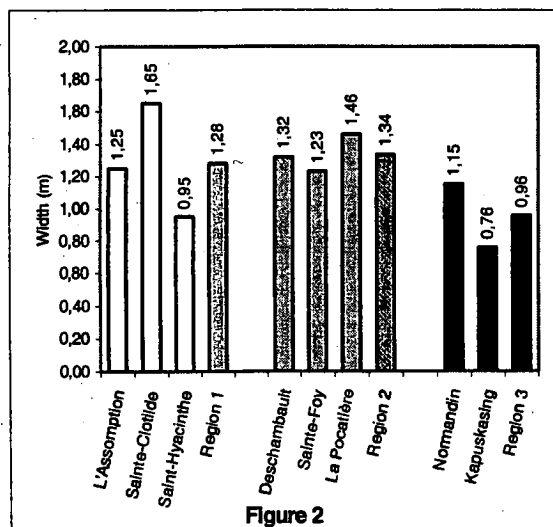


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Growth was slow in region 3, due to the severe pruning required.

Height growth at Saint-Hyacinthe did not increase after the end of the fourth year.

At all sites, width exceeded height by the fourth year.

Effect of pruning

Extensive pruning had to be done every spring on all plants in region 3.

Flowering

Shrubs at all region 1 and 2 sites and Normandin produced flowers every year. Flowering began between May 29 and June 9 and lasted 32-43 days. In region 2, flowers appeared 9-11 days later; the duration of flowering was 32-34 days at La Pocatière and 41-110 days at the other two sites. In region 3, at Normandin, flowering began between June 12 and June 26 and lasted 40-45 days. At Kapuskasing, a few plants flowered the last two years of the trial; flowering began between June 23 and July 9 and lasted 63-66 days. The first flowering is characterized by an abundance of flowers; recurrent flowering involved much fewer flowers over a longer period.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After three growing seasons, all shrubs at L'Assomption, Deschambault, Sainte-Foy and La Pocatière were over 81 cm tall. An additional year was required at Sainte-Clotilde, Saint-Hyacinthe and Normandin to reach this height.

The cultivar can be produced more quickly at the region 2 sites, since the snow cover protects the plants better from the first frosts in fall and from the cold throughout the winter.

HARDINESS EVALUATION

The species is usually considered to be hardy to zone 5. The trial results for 'Red Prince' show that it can survive as far as zone 2b, given adequate snow cover. It can also be used as far as zone 2b, with the proviso that spring pruning will reduce the abundance of flowers during the first flowering at all sites (this also applies to sites in regions 1 and 2).

The cultivar did not achieve its full ornamental potential during the trial; this can only be achieved outside the regions tested.

BIBLIOGRAPHIC REFERENCES

3, 7, 21

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Claude Richer, Agr.

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Chantal Gauthier, Horticulturist

Table 1. Frequency of winter damage observed on *Weigela* 'Red Prince' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	3	4	5	6	7	8	10	11	
REGION 1											
L'Assomption	13	72			2					13	87
Sainte-Clotilde	42	42		15				1			58
Saint-Hyacinthe	38	43			5			14			62
REGION 2											
Deschambault	48	31		1	2				13	5	52
Sainte-Foy	40	60									60
La Pocatière	37	56							7		63
REGION 3											
Normandin	53	7				13	7		20		47
Kapuskasing	0	16		45			25	14			100

- ^a Key:
- | | |
|----------------------------------------------------|--------------------------------------------------------|
| 1 = no damage | 7 = dead down to the ground surface |
| 2 = damage to the tip of the previous year's shoot | 8 = dead |
| 3 = frost damage on the flower buds | 9 = sunscald, trunk spitting |
| 4 = previous year's shoot affected | 10 = mechanical breakage related to weather conditions |
| 5 = old wood affected | 11 = damage by rodents |
| 6 = dead down to the level of snow cover | |

No damage of type 3 and 9 occurred for this cultivar.

Table 2. Breakdown of *Weigela* 'Red Prince' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	5	0	0	0	0	6	0	0	0	0	0	0	0	0	0
041-080	95	10	0	0	0	94	100	10	0	0	95	36	36	9	10
081-120	0	90	75	92	75	0	0	90	17	0	5	64	64	64	50
121-160	0	0	25	8	25	0	0	0	83	75	0	0	0	27	40
161-200	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	5	0	0	0	0	5	0	0	0	0	10	0	0	0	0
041-080	95	14	0	0	0	95	0	0	8	0	90	43	0	0	0
081-120	0	86	100	83	25	0	100	100	0	50	0	57	59	58	25
121-160	0	0	0	17	75	0	0	0	92	50	0	0	41	42	75
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 3															
Height (cm)	Normandin					Kapuskaing									
	92	93	94	95	96	92	93	94	95	96					
001-040	10	0	0	0	0	81	83	40	0	0					
041-080	90	62	75	0	0	19	17	60	100	100					
081-120	0	38	25	100	100	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					
161-200	-	-	-	-	-	-	-	-	-	-					

Table 3. Breakdown of *Weigela* 'Red Prince' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-030	90	0	0	0	0	85	0	0	0	0	100	65	0	0	0
031-060	10	40	10	0	0	15	55	43	0	0	0	35	64	0	0
061-090	0	60	90	45	25	0	45	36	45	0	0	0	36	56	25
091-120	0	0	0	55	43	0	0	21	55	25	0	0	0	44	75
121-150	0	0	0	0	32	0	0	0	0	75	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-030	80	0	0	0	0	67	0	0	0	0	67	95	0	0	0
031-060	20	67	34	0	0	33	78	45	0	0	33	0	45	0	0
061-090	0	33	43	54	0	0	22	35	56	43	0	5	55	63	0
091-120	0	0	23	46	67	0	0	20	44	38	0	0	0	37	44
121-150	0	0	0	0	33	0	0	0	0	19	0	0	0	0	56
REGION 3															
Width (cm)	Normandin					Kapuskasing									
	92	93	94	95	96	92	93	94	95	96					
001-030	90	0	0	0	0	100	60	5	0	0					
031-060	10	85	34	0	0	0	40	67	37	25					
061-090	0	15	45	67	25	0	0	28	63	75					
091-120	0	0	21	33	75	-	-	-	-	-					
121-150	-	-	-	-	-	-	-	-	-	-					

WEIGELA 'SAMBA'

Family:	Caprifoliaceae
English name:	Samba Weigela
French name:	Weigela 'Samba'
Category:	Deciduous plant
Subdivision:	Shrub

BOTANICAL DESCRIPTION

This vigorous shrub is very compact in habit, growing to barely 1 m high and wide.

The young shoots are reddish but turn grey and arching with age.

The abundant leaves are wide and oval in shape, measuring 2.5-3.5 cm long, and have an acuminate tip. They are dark green at the base and in the centre, with purplish margins and petioles. The foliage turns purplish grey in fall.

The flowers bloom abundantly and spectacularly in summer from two-year-old wood; recurrent flowering occurs in the summer from the new shoots. The bell-shaped, purplish-red flowers with yellow centres are 2.5 cm in diameter. The corolla tube is 4.0-4.5 cm long.

The roots are fine and very numerous. Growth is slow in this cultivar.

ORIGIN AND DISTRIBUTION

This cultivar is the result of a cross between *Weigela* 'Rumba' and *Weigela* 'Eva Rathke'. The cultivar 'Rumba' comes from a cross between *W. florida* 'Foliis Purpureus' and *W. florida* 'Dropmore Pink'. The cultivar 'Eva Rathke' was introduced in 1892 by Rathke.

USE

Ornamental: The cultivar is used alone, in groups and in mass plantings with other plants. It is prized for its spectacular flowering and the colour of the foliage.

REQUIREMENTS

This cultivar prefers full sun but will also tolerate light shade. In the shade, however, its floral characteristics and habit will be less attractive. It is not demanding about soil, but does best in a well-drained situation.

The cultivar transplants well. Pruning, when required, should be done after the first flowering. Pruning involves removing the branches that have already flowered to make way for the new shoots that will bear the next crop of flowers.

DISEASES AND INSECTS

In general, members of the genus are resistant to disease. No major diseases seem to affect this cultivar.

Two flea beetles often cause significant damage in the genus: the western black flea beetle (*Phyllotreta pusilla*) and the redheaded flea beetle (*Systema frontalis*).

PROPAGATION

Cuttings: Hardwood cuttings taken in fall, or semiripe cuttings taken in June after flowering, and placed under a mist unit root readily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation site: Agriculture and Agri-Food Canada's Experimental Farm, L'Assomption (Quebec)

Propagation technique: 400 cuttings (5 cm long) were taken on July 15, 1991 from one-year-old parent plants measuring roughly 30 cm tall and 20 cm wide. They were dipped for five seconds in a 5,000-ppm IBA/50 % ethanol solution. The seedlings were planted in flats filled with a Promix®-Turface®-sand mixture (2:2:1; v:v:v), and placed under a mist unit (Mist-A-Matic®). The temperature of the heating cables was set at 25 °C. A weekly fungicide treatment (Benomyl®) was provided throughout the propagation period. The rooting rate was 50 % after three weeks. Misting was discontinued and the seedlings were fertilized with a 10-52-10 solution at the recommended rate. On August 12, the seedlings were put in the lath house and then, in fall, in the cold store at 5 °C. On April 22, 1992, they were wrapped and put in the cold store to await shipping in May.

Inclusion in testing network: Seedlings 4 cm high were planted at eight test sites throughout Quebec and northeastern Ontario. Winter hardiness and growth potential were evaluated from 1992 to 1997.

RESULTS (1992-97)

Winter damage

Table 1 shows the frequency of winter damage observed in the cultivar over a five-year period. Details are provided below of the main types of damage that occurred each winter at each of the sites.

Region 1

At L'Assomption, the only damage was to the branch tips in the second, fourth and fifth winters, in 70 %, 67 % and 100 % of shrubs.

At Sainte-Clotilde, 43 % of seedlings suffered rodent damage the first winter. Frost damage to the branch tips occurred in 33 % of shrubs the third and fourth winters.

At Saint-Hyacinthe, six seedlings died the first winter and another died the second winter. The last four winters, 33 %, 100 %, 13 % and 50 % of shrubs suffered frost damage to the branch tips. Half the plants suffered rodent damage the last winter.

Region 2

At Sainte-Foy, only three shrubs suffered frost damage to the branch tips the fourth winter.

At Deschambault, the only damage was mechanical breakage, which occurred in all plants the last winter.

At La Pocatière, 33 % of seedlings suffered frost damage to the branch tips the second winter.

Region 3

The second winter at Normandin, 25 % of seedlings died. The first winter, all seedlings suffered frost damage down to the ground level and, the second winter, 75 % suffered damage to the branch tips. The last winter, mechanical breakage occurred in all the shrubs.

At Kapuskasing, all plants died over the first four winters. During the first three winters, all the surviving plants had frost damage down to the ground level.

Height and width growth

Figures 1 and 2 show the mean height and width of the plants after five years at each site in the three regions.

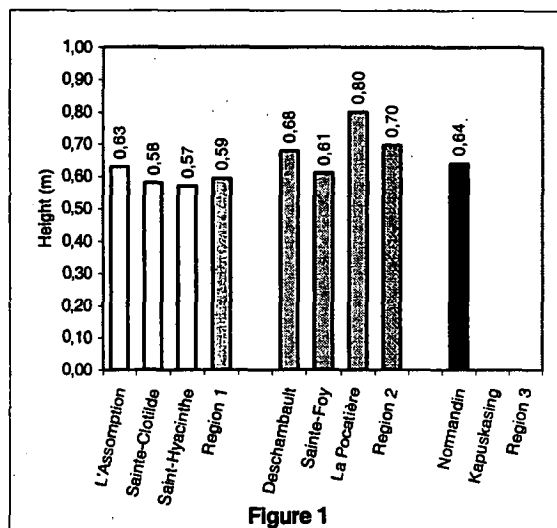


Figure 1

Figure 1. Mean height of shrubs at trial's end at each of the eight sites and three regions

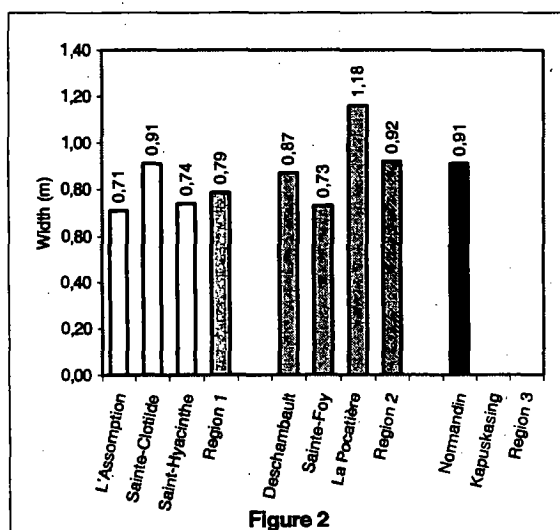


Figure 2

Figure 2. Mean width of shrubs at trial's end at each of the eight sites and three regions

Slow but regular growth was observed in regions 1 and 2 and Normandin.

By the second winter, width exceeded height at all sites except L'Assomption, where this occurred the third year.

Effect of pruning

Light pruning was all that was required at the region 1 and 2 sites. Pruning was much more extensive at Normandin and Kapuskasing.

Flowering

At all region 1 and 2 sites except Sainte-Clotilde, flowering began the first year after planting. In region 1, flowering began between May 23 and June 20, ending 10-30 days later. In region 2, flowering began June 5-16 at Deschambault and Sainte-Foy, but 3-7 days later at La Pocatière; duration was 12-32 days. In region 3, flowering was restricted to a few plants at Normandin; flowering began from the new shoots between June 12 and August 12, with a duration of 13-30 days.

PRODUCTION RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants obtained at each test site after each year by height and width categories (heights and widths are those obtained at the end of each year). Nursery operators will find these tables useful for estimating annual production and the number of years needed to obtain a given height and width.

After three growing seasons, all shrubs at L'Assomption, Sainte-Foy and La Pocatière were over 41 cm high. An additional year was required at Sainte-Clotilde and Deschambault and another year at Saint-Hyacinthe and Normandin to reach this height.

The cultivar can be produced in regions 1 and 2, as long as it is adequately protected from the first fall frosts and throughout the winter.

HARDINESS EVALUATION

According to the hybridizer of this cultivar, Ms. Svejda, it is hardy to zone 4. The test results show that frost damage was much lighter in region 2 (zones 4a and 4b) than in the other two regions. The cultivar's small size, combined with

the region's heavy snow cover, which is laid down early in fall and remains throughout winter, explains this performance.

The cultivar can survive as far as zone 2b, as long as the snow cover is adequate. It can also be used as far as zone 2b, with the proviso that spring pruning will reduce the abundance of flowers in the first flowering.

The cultivar did not achieve its full ornamental potential at the sites tested and can only do so in other regions.

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3, 7, 18, 21, 76

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Table 1. Frequency of winter damage observed on *Weigela* 'Samba' from 1993 to 1997

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ³										
		1	2	3	4	5	6	7	8	10	11	
REGION 1												
L'Assomption	53	47										47
Sainte-Clotilde	78	13								9		22
Saint-Hyacinthe	41	39						10		10		59
REGION 2												
Deschambault	80								20			20
Sainte-Foy	95	5										5
La Pocatière	93	7										7
REGION 3												
Normandin	40	15					20	5	20			60
Kapuskasing	0						35	65				100

^a Key:

1 = no damage	7 = dead down to the ground surface
2 = damage to the tip of the previous year's shoot	8 = dead
3 = frost damage on the flower buds	9 = sunscald, trunk spitting
4 = previous year's shoot affected	10 = mechanical breakage related to weather conditions
5 = old wood affected	11 = damage by rodents
6 = dead down to the level of snow cover	

No damage of type 3, 4, 5, 6 and 9 occurred for this cultivar.

Table 2. Breakdown of *Weigela* 'Samba' plants by marketable height category from 1992 to 1996

REGION 1															
Height (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	65	0	0	0	0	85	0	0	0	0	100	0	0	0	0
021-040	35	85	0	0	0	15	100	25	0	0	0	67	38	25	0
041-060	0	15	83	92	42	0	0	75	8	0	0	33	52	75	87
061-080	0	0	17	8	58	0	0	0	92	100	0	0	0	0	13
081-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Height (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-020	87	0	0	0	0	84	0	0	0	0	67	0	0	0	0
021-040	13	75	33	8	0	16	37	0	0	0	33	67	0	0	0
041-060	0	25	67	67	33	0	63	92	50	42	0	33	55	9	0
061-080	0	0	0	25	59	0	0	8	50	58	0	0	45	91	73
081-100	0	0	0	0	8	-	-	-	-	-	0	0	0	0	27
REGION 3															
Height (cm)	Normandin					Kapuskasing*									
	92	93	94	95	96	92	93	94	95	96					
001-020	94	0	18	0	0	100	100	100	100	-					
021-040	6	50	27	18	0	-	-	-	-	-					
041-060	0	50	55	46	27	-	-	-	-	-					
061-080	0	0	0	36	73	-	-	-	-	-					
081-100	-	-	-	-	-	-	-	-	-	-					

*At Kapuskasing, plants died during the first four winters.

Table 3. Breakdown of *Weigela* 'Samba' plants by marketable width category from 1992 to 1996

REGION 1															
Width (cm)	L'Assomption					Sainte-Clotilde					Saint-Hyacinthe				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	95	8	0	8	100	75	0	0	0	100	11	13	0	0
041-080	0	5	92	100	67	0	25	100	58	22	0	89	87	100	75
081-120	0	0	0	0	25	0	0	0	42	78	0	0	0	0	25
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
REGION 2															
Width (cm)	Deschambault					Sainte-Foy					La Pocatière				
	92	93	94	95	96	92	93	94	95	96	92	93	94	95	96
001-040	100	25	0	25	0	100	5	0	0	0	100	0	0	0	0
041-080	0	75	100	50	17	0	95	100	58	67	0	100	45	0	0
081-120	0	0	0	25	83	0	0	0	42	33	0	0	55	100	73
121-160	-	-	-	-	-	-	-	-	-	-	0	0	0	0	27
REGION 3															
Width (cm)	Normandin					Kapusking*									
	92	93	94	95	96	92	93	94	95	96					
001-040	100	33	27	0	0	100	100	100	100	-					
041-080	0	67	73	55	27	-	-	-	-	-					
081-120	0	0	0	45	73	-	-	-	-	-					
121-160	-	-	-	-	-	-	-	-	-	-					

*At Kapuskasing, plants died during the first four winters.

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ANNEX 1. PATHOLOGY AND INSECTS ON ROSES

ROSE DISEASES

Mosaic on rose

Several different viruses infect roses and mosaic is a symptom. Rose mosaic is the most common. This is an old disease which occurs in nurseries, gardens and commercial field plantings. Serious damage is not usually observed, however stunting and poor growth can occur. Most rose viruses are spread from plant to plant by graft transmission rather than by insects which is common for most viruses.

Powdery mildew (*Sphaerotheca applanata* var. *rosae*)

The infection results in a white powdery substance on the leaves, buds and twigs causing distorted and dwarfed leaves. Petals, sepals and receptacles of the flower buds are also subject to attack. Frequently, the unopened buds are affected to any great extent. The disease is more likely to occur during cool, dry conditions and can spread rapidly. Powder mildew is usually not a season-long problem.

Botrytis blight (*Botrytis cinerea*)

This disease prevents the blooms from opening. The buds turn brown and decay. Sometimes, partially opened flowers are attacked, the individual petals turning brown and shriveling. The fungus is always present in rainy seasons when the old blooms are not gathered. Winter-killed canes also harbor the fungus.

Rust (*Phragmidium disciflorum*)

Infection sites result in small, orange or yellow pustules on green portions of the plant. In early spring, these masses may be inconspicuous as to be unnoticed. In the late summer or early fall, the spots change and black pustules appear, frequently in the same affected areas. These pustules overwinter within the leaf and the stem tissue after leaves have fallen and later produce the spores that cause the spring infection.

Black spot

The spores of the fungus are dispersed by splashing raindrops and not by wind. The presence of free moisture is necessary for black spot infection to occur. The primary symptoms are irregularly-shaped black spots with feathery edges often surrounded by a yellow halo on the foliage. Infected leaves eventually drop off and this will be more severe under warm temperatures rather than cool temperatures. Heavy infection causes excessive and premature defoliation, reducing the carbohydrate contents of canes and roots which in turn reduces the amount of subsequent foliage and flowering parts. Infection can also occur on petioles, twigs and canes.

INSECTS ON ROSES

Thrips (*Tetranychus urticae*)

The two-spotted mite (0,3 to 0,5 mm long) is green yellowish. It is a greenhouse pest but can also do much damage in garden roses. Feeding damage of this green spider mite results in stippled spotting causing yellowing or bronzing of completely fed-over leaves that drop prematurely.

Megachile of rose (*Megachile centuncularis*)

External sides of the leaves appear to be cut in small semi-circles and these damages are caused by grey or reddish bees.

Aphids

Insects rapidly infest flower buds, stalks and on the under sides of the leaves. Two species of aphids (green or greenish colors) are mostly infest the roses. The small rose aphid (*Macrosiphum rosae*) injured the plants, caused a poor growth and a decreasing flowering period. The small green aphid of apple (*Aphis pomi*) caused a leaf curl and a poor growth.

Foliage sawfly (*Arge rosae*, *Arge pagana*)

These are small yellow and black wasps. Larvae ate the limb of foliage without attack to the internal epidermis and nervations. Older, they cut leaves irregularly.

Stem sawfly (*Blennocampa elongatula*, *Ardis bruniventris*, *Ardis sulcata*)

Stems and new shoots are affected by false caterpillars. They burrow increasing galleries (*Blennocampa elongatule*; larva is yellow-brown with a brown head) or decreasing galleries (*Ardis bruniventris* or *Ardis sulcata*; larva is yellowish with a dark yellow head). Shoots faded.

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