



HARDINESS AND GROWTH OF WOODY ORNAMENTAL PLANTS IN QUEBEC

Conseil des productions végétales du Québec inc.
REPLOQ Results and Recommendations

Claude Rite

REPLOG

HARDINESS AND GROWTH OF WOODY ORNAMENTAL PLANTS IN QUEBEC

REPLOQ Results and Recommendations

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FOREWORD

This report was prepared by the Atelier REPLOQ (Réseau d'essais des plantes ligneuses ornementales du Québec) [Quebec ornamental woody plant testing network workshop] of the Comité Horticulture ornementale [Ornamental horticulture committee] of the Conseil des productions végétales du Québec inc.

It outlines the results and recommendations concerning the ornamental woody species evaluated by REPLOQ for the 1985-1991 period.

Other reports are planned in order to convey the results of other tests conducted during the 1987-1992 period. If you would like to be informed of the publication of these results, complete and return the form on page 467.

ACKNOWLEDGMENTS

The REPLOQ testing was made possible by the financial support of **Agriculture and Agri-Food Canada** and the **Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec**.

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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

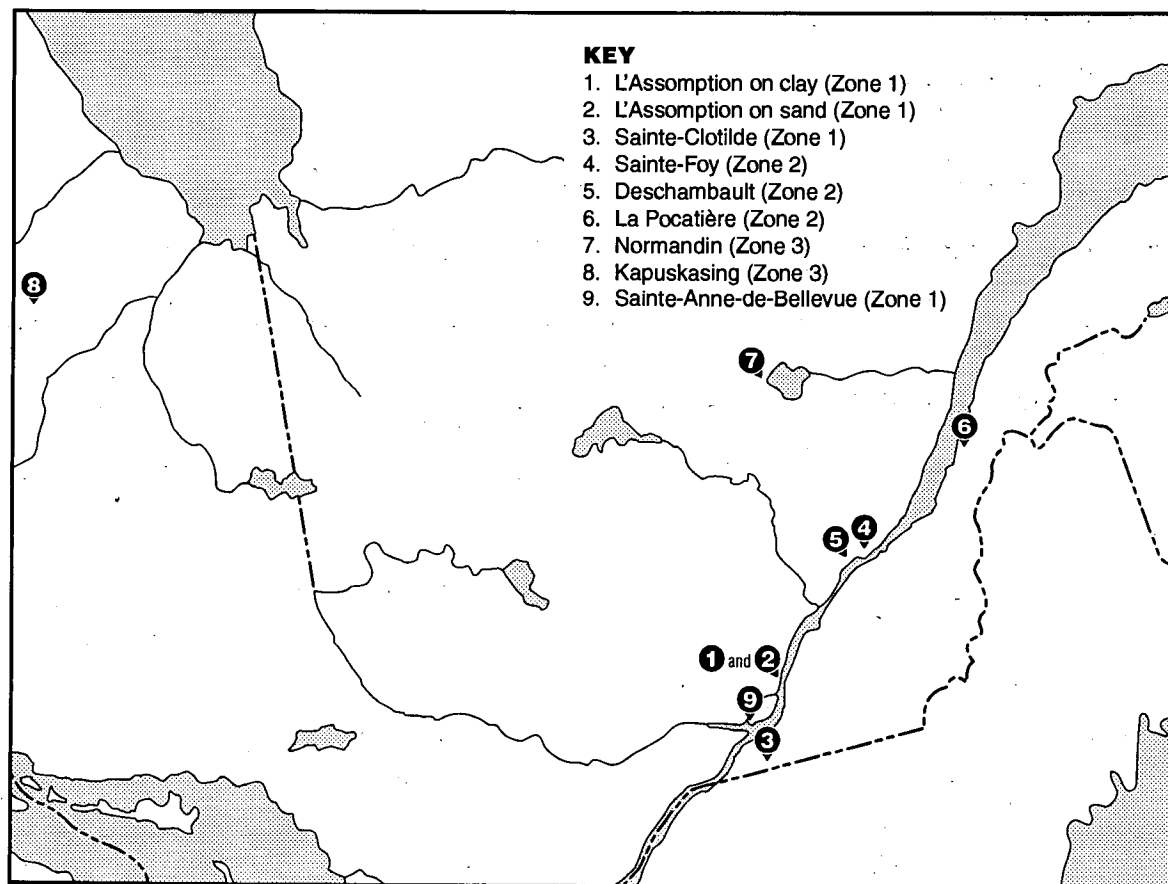
characteristics which might influence the growth of ornamental woody plants. REPLOQ has eight or nine test sites, depending on the year, located in three adaptation zones (see map below).

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.

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 regions.



INFORMATION ON REPLOQ TESTING (cont'd)

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* 'Argenteo-Marginata'
or
Juniperus sabina
4. Climbing and creeping plants
Control: *Parthenocissus quinquefolia*

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 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 1985 and 1986 plantings:

Sainte-Clotilde	<i>Charles Péron and Michel Fortin</i>
Sainte-Anne-de-Bellevue	<i>Mike Blého</i>
L'Assomption	<i>Claude Richer and Jacques Côté</i>
Sainte-Foy	<i>Jacques-André Rioux and Isabelle Duchesne</i>
Deschambault	<i>Antoine Laflamme and Sylvie Atkins</i>
La Pocatière	<i>Michel Auger and Andrew Frère</i>
Normandin	<i>Raynald Drapeau</i>
Kapuskasing	<i>Laurier Guillemette</i>

For the 1986 planting, the Sainte-Anne-de-Bellevue site was eliminated from the testing. It was replaced by the Saint-Hyacinthe site beginning with the 1987 planting.

I would particularly like to thank Jacques Côté, who was assigned to this research project at L'Assomption.

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 publications to find out how to obtain these reports).

Latin name	English name	French name
<i>Acer platanoides</i> ¹	Norway maple	Érable de Norvège, faux sycomore
<i>Acer saccharinum</i> ¹ (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	Kerria, corète du Japon
<i>Lonicera korolkowii</i> var. <i>Zabeli</i> ²	Blue-leaf honeysuckle	Chèvrefeuille de Zabel
<i>Lonicera Morrowii</i> ²	Morrow honeysuckle	Chèvrefeuille de Morrow
<i>Lonicera xylostoides</i> 'Clavey's Dwarf' ²	Clavey's dwarf honeysuckle	Chèvrefeuille nain 'Clavey's Dwarf'
<i>Malus baccata</i> ² (C)	Siberian crabapple	Pommétier de Sibérie, pommétier 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	Physocarpe à feuilles d'obier, bois à sept écorces
<i>Physocarpus opulifolius</i> 'Aureus' ²	Golden common ninebark	Physocarpe doré à feuilles d'obier
<i>Physocarpus opulifolius</i> 'Nanus' ²	Dwarf common ninebark	Physocarpe 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 or 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 arctic willow, purple willow	Saule arctique, saule pourpre nain
<i>Viburnum opulus</i> 'Compactum' ¹	Dwarf or 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. See page 465.

2. Species dealt with in the second series (02-9309). Available in French only. See page 465.

(C): control

**List of ornamental woody plants tested by REPLOQ,
in chronological order of planting**

Introduced in 1985 - Evaluated until 1990

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 or bouleau des rivières
<i>Betula pendula</i>	European white birch	Bouleau européen or bouleau 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>	Virginsbower	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'	Skogholmen bearberry cotoneaster	Cotonéastre 'Skogholmen'
<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 involucré
<i>Malus baccata</i> (C)	Siberian crabapple	Pommétier 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>	Rhododendron	Rhododendron
<i>Shepherdia argentea</i>	Buffaloberry	Shépherdie argentée
<i>Thuja occidentalis</i> (C)	American arborvitae, white cedar	Thuja occidental, thuya du Canada
<i>Thuja occidentalis</i> 'Fastigiata'	Columnar American arborvitae, pyramidal arborvitae	Thuja occidental fastigié
<i>Thuja occidentalis</i> 'Lutea'	George Peabody arborvitae	Thuja occidental doré
<i>Thuja occidentalis</i> 'Reidii'	Reid American arborvitae	Thuja occidental 'Reidii'
<i>Thuja occidentalis</i> 'Wareana'	Siberian arborvitae, Siberian cedar	Thuja de Sibérie
<i>Thuja occidentalis</i> 'Woodwardii'	Woodward American arborvitae	Thuja 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 in 1991

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>	Pagoda, alternated-leaved dogwood	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, burningbush	Fusain compact
<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	Pommettier de Sibérie
<i>Philadelphus x virginialis</i> 'Minnesota Snowflake'	Minnesota snowflake mock orange	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	Thuja occidental
<i>Thuja occidentalis</i> 'Little Champion'	Little champion American arborvitae	Thuja occidentale 'Little Champion'
<i>Thuja occidentalis</i> 'Pulcherrima'	Golden American arborvitae	Thuja occidentale doré
<i>Thuja occidentalis</i> 'Smaragd'	Smaragd American arborvitae	Thuja 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' (origin: Montreal)	Bristol ruby weigela	Weigela 'Bristol Ruby'

**List of ornamental woody plants tested by REPLOQ,
from 1984 to 1986, in alphabetical order**

A

Acer Ginnala
Acer negundo
Acer platanoides
Acer rubrum
Acer saccharinum (1984, 1985 and 1986) (C)
Acer tataricum
Aesculus hippocastanum
Actinidia Kolomikta
Alnus crispa
Alnus glutinosa

B

Betula alleghaniensis
Betula nigra
Betula pendula 1985, 1986 (origin: Russia)

C

Calluna vulgaris 'Alportii'
Caragana arborescens
Caragana spinosa
Carpinus caroliniana var. virginiana
Celtis occidentalis
Clematis virginiana
Cornus alba 'Argenteo-Marginata' (1984, 1985 and 1986) (C)
Cornus alba 'Sibirica'
Cornus alba 'Spaethii'
Cornus alternifolia
Cornus sanguinea
Cornus sericea 'Flaviramea'
Corylus avellana x cornuta
Cotoneaster apiculatus
Cotoneaster dammeri 'Coral Beauty'
Cotoneaster dammeri 'Skogholm'
Cotoneaster horizontalis var. perpusillus

E

Elaeagnus angustifolia
Elaeagnus commutata
Erica carnea 'Praecox'
Euonymus alata
Euonymus alatus 'Compactus'
Euonymus europaeus

F

Forsythia ovata 'Northern Gold'

H

Hippophae rhamnoides
Hydrangea arborescens 'Annabelle'
Hydrangea paniculata 'Grandiflora'

J

Juniperus chinensis 'Hetzii'
Juniperus conferta
Juniperus sabina (1985) (C)
Juniperus virginiana

K

Kerria japonica

L

Larix decidua
Larix laricina (1986) (C)
Lonicera involucrata
Lonicera korolkowii var. Zabelli
Lonicera Morrowii
Lonicera xylosteoides 'Clavey's Dwarf'

M

Magnolia kobus
Malus baccata (1984, 1985 and 1986) (C)
Myrica Gale

P

Parthenocissus quinquefolia (1984 and 1985) (C)
Paxistima canbyi
Philadelphus x virginalis 'Minnesota Snowflake'
Philadelphus x virginalis 'Virginal'
Physocarpus opulifolius
Physocarpus opulifolius 'Aureus'
Physocarpus opulifolius 'Nanus'
Picea pungens
Picea pungens 'Glauca'
Pinus nigra 'Austriaca'
Pinus sylvestris
Potentilla fruticosa 'Abbotswood'
Potentilla fruticosa 'Daydawn'
Potentilla fruticosa 'Goldfinger'
Potentilla fruticosa 'Snowflake'
Prunus x cistena
Prunus padus
Prunus tomentosa 1984, 1986 (origin: Morden)

**List of ornamental woody plants tested by REPLOQ,
from 1984 to 1986, in alphabetical order
(cont'd)**

Q

Quercus macrocarpa
Quercus palustris
Quercus robur 'Fastigiata'
Quercus rubra

R

Rhododendron carolinianum var. album
Rhododendron carolinianum var. roseum
Rhododendron mucronulatum
Ribes aureum
Ribes sanguineum
Rosa 'Martin Frobisher'
Rosa x Metis
Rosa multiflora
Rosa rugosa var. typica

S

Salix Elaeagnos
Salix purpurea 'Nana'
Shepherdia argentea
Spiraea japonica 'Goldmound'
Spiraea nipponica 'Snowmound'
Syringa reticulata

T

Tamarix ramosissima
Thuja occidentalis (1985 and 1986) (C)
Thuja occidentalis 'Fastigiata'
Thuja occidentalis 'Little Champion'
Thuja occidentalis 'Lutea'
Thuja occidentalis 'Pulcherrima'
Thuja occidentalis 'Reidii'
Thuja occidentalis 'Smaragd'
Thuja occidentalis 'Wareana'
Thuja occidentalis 'Woodwardii'

U

Ulmus pumila

V

Viburnum carlesii
Viburnum lantana
Viburnum Lentago
Viburnum opulus 'Compactum'
Viburnum opulus 'Nanum'
Viburnum opulus 'Roseum'
Viburnum trilobum

W

Weigela florida 'Variegata'
Weigela hybrida 'Bristol Ruby' 1984, 1986 (origin: Montreal)

**List of ornamental woody plants tested by REPLOQ,
by woody plant category**

LARGE DECIDUOUS TREES

Acer negundo
Acer platanoides
Acer rubrum
Acer saccharinum (C)
Aesculus hippocastanum
Betula alleghaniensis
Betula nigra
Betula pendula
Celtis occidentalis
Quercus macrocarpa
Quercus palustris
Quercus robur 'Fastigiata'
Quercus rubra
Ulmus pumila

SMALL DECIDUOUS TREES

Acer ginnala
Acer tataricum
Alnus glutinosa
Carpinus caroliniana var. *virginiana*
Comus alternifolia
Elaeagnus angustifolia
Magnolia kobus
Malus baccata (C)
Prunus padus
Prunus tomentosa
Salix Elaeagnos
Shepherdia argentea
Syringa reticulata
Viburnum lentago

SHRUBS

Alnus crispa
Caragana arborescens
Caragana spinosa
Cornus alba 'Argenteo-Marginata' (C)
Cornus alba 'Sibirica'
Cornus alba 'Spaethii'
Comus sericea 'Flaviramea'
Cornus sanguinea
Corylus avellana x *cornuta*
Cotoneaster apiculatus
Elaeagnus commutata
Euonymus alata
Euonymus alatus 'Compactus'
Euonymus europaeus

SHRUBS (cont'd)

Hippophae rhamnoides
Hydrangea arborescens 'Annabelle'
Hydrangea paniculata 'Grandiflora'
Kerria japonica
Lonicera involucrata
Lonicera korolkowii var. *Zabelli*
Lonicera Morrowii
Lonicera xylosteoides 'Clavey's Dwarf'
Myrica Gale
Philadelphus x virginalis 'Minnesota Snowflake'
Philadelphus x virginalis 'Virginal'
Physocarpus opulifolius
Physocarpus opulifolius 'Aureus'
Physocarpus opulifolius 'Nanus'
Potentilla fruticosa 'Abbotswood'
Potentilla fruticosa 'Daydawn'
Potentilla fruticosa 'Goldfinger'
Potentilla fruticosa 'Snowflake'
Prunus x cistena
Ribes aureum
Ribes sanguineum
Rosa 'Martin Frobisher'
Rosa x Metis
Rosa multiflora
Rosa rugosa var. *typica*
Salix purpurea 'Nana'
Shepherdia argentea
Spiraea japonica 'Goldmound'
Spiraea nipponica 'Snowmound'
Tamarix ramosissima
Viburnum carlesii
Viburnum lantana
Viburnum opulus 'Compactum'
Viburnum opulus 'Nanum'
Viburnum opulus 'Roseum'
Viburnum trilobum
Weigela florida 'Variegata'
Weigela hybrida 'Bristol Ruby'

CLIMBING AND CREEPING PLANTS

Actinidia Kolomikta
Cotoneaster dammeri 'Coral Beauty'
Cotoneaster dammeri 'Skogholm'
Cotoneaster horizontalis var. *perpusillus*
Parthenocissus quinquefolia (C)
Paxistima canbyi

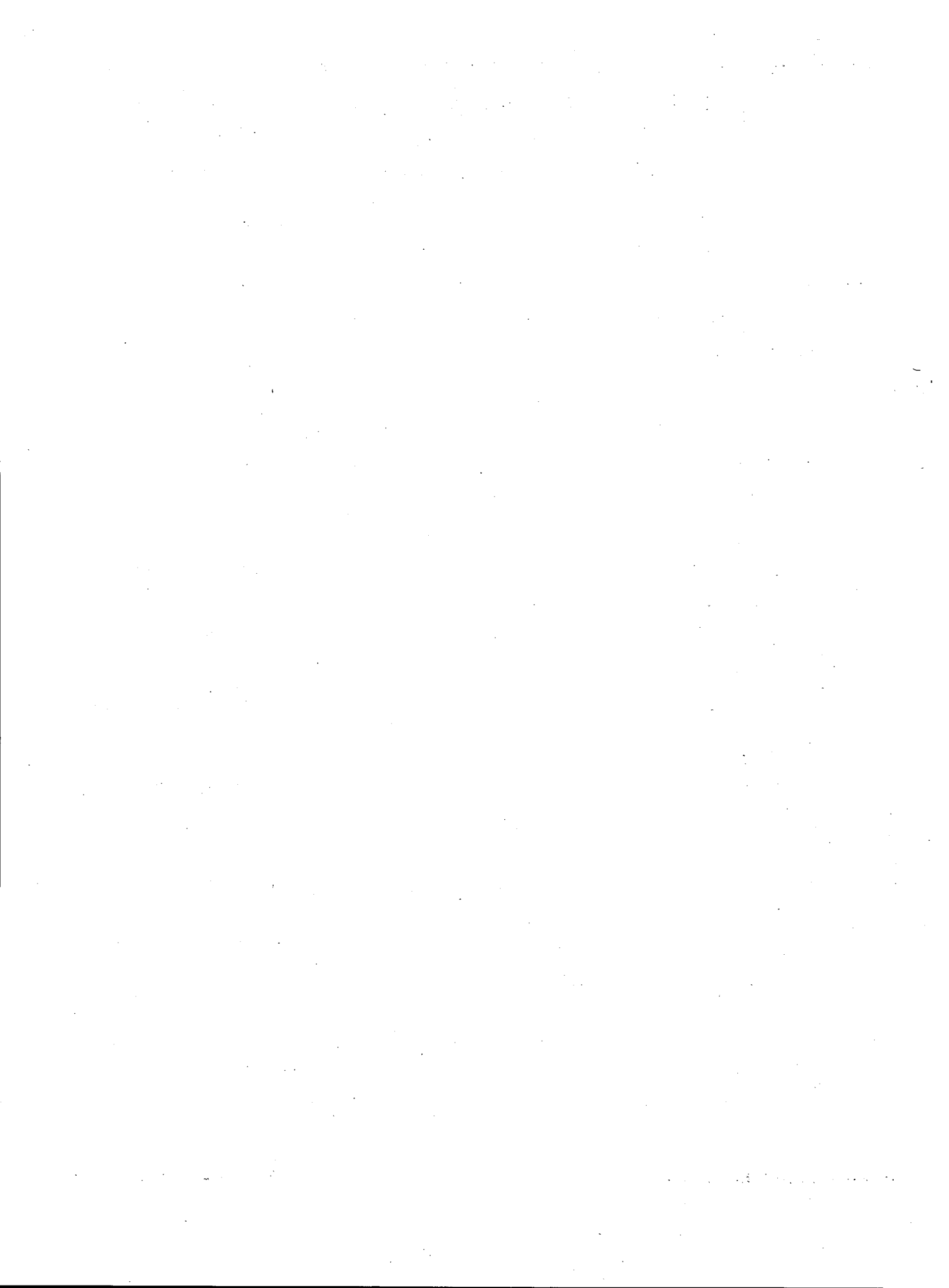
**List of ornamental woody plants tested by REPLOQ,
by woody plant category (cont'd)**

ERICACEAE

Calluna vulgaris 'Alportii'
Erica carnea 'Praecox'
Rhododendron carolinianum var. album
Rhododendron carolinianum var. roseum
Rhododendron mucronulatum

EVERGREENS

Juniperus chinensis 'Hetzii'
Juniperus conferta
Juniperus sabina (C)
Juniperus virginiana
Larix decidua
Larix laricina (C)
Picea pungens
Picea pungens 'Glauca'
Pinus nigra 'Austriaca'
Pinus sylvestris
Thuja occidentalis (C)
Thuja occidentalis 'Fastigiata'
Thuja occidentalis 'Little Champion'
Thuja occidentalis 'Lutea'
Thuja occidentalis 'Pulcherrima'
Thuja occidentalis 'Reidii'
Thuja occidentalis 'Smaragd'
Thuja occidentalis 'Wareana'
Thuja occidentalis 'Woodwardii'



Acer Ginnala Maxim.

See colour plate

Family	:	Aceracea
English name	:	Amur maple, Siberian maple
French name	:	Érable de l'Amur, Érable de l'Amour
Synonym	:	<i>Acer Ginnala</i> var. <i>ruginnala</i> Pax; <i>A. tataricum</i> var. <i>aidzuense</i> Franck
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

The samaras are 2 to 3 cm long and are composed of two narrow, parallel wings. They remain suspended from the branches from July until late fall, or sometimes even until the following spring. The colour of the samaras ranges from red to pink during the summer season; this is one of the ornamental attractions of this species.

ORIGIN AND DISTRIBUTION

In 1800, Frank Meyer discovered the first *Acer Ginnala* plants in Ts'ing-tao, China. This Asian shrub ranges from Manchuria to Korea and Japan. It was introduced in the United States and in the USSR in 1860. It is used in the United States, particularly in South Dakota, Minnesota, Maine, and from Connecticut to western New York State.

USE

Ornamental: This small tree is valuable because of its ability to adapt to various environments. It is hardy and beautiful year-round, but it is particularly remarkable in July for the colour of its fruit and in the fall for its scarlet foliage. As a shrub, it produces a pleasing effect on a lawn or terrace and can be used to create a high screen. It is used in groups or in isolation to form a free hedge or to stabilize the soil on slopes.

REQUIREMENTS

This easy-to-grow maple is one of the most cold-resistant. It adapts to sunny or semi-shady sites, to practically all soil types, wet or dry, as well as to difficult urban conditions. Some nursery growers grow it as a small, single-trunk tree, but this is a mistake because in this shape it has a tendency to be susceptible to canker. It is preferable to grow it in clumps or as a single-trunk tree branching out near the ground.

PATHOLOGY

This species is generally grown without any problems and has good resistance to disease. However, when poorly maintained, it becomes susceptible to canker (*Nectria cinnabarrina*). It is attacked by the same insects as *Acer saccharinum* L.

BOTANICAL DESCRIPTION

This small tree with a rounded growth habit and spreading crown can reach a height and width of 6 m. It is generally composed of several large branches issuing from a very short trunk, near the ground, but it is also grown as a multi-stemmed tree.

The young branches are purple. The older stems are glabrous, thin and greyish-brown. The oldest parts are rough and bare.

The buds are small (3-4 mm), overlapping, opposite and glabrous, with colours ranging from reddish-brown to flame red.

The leaves are opposite, oblong, triangular and three-lobed, with the central lobe being wider than the lateral lobes. They are 5 to 7 cm long and 3 to 5 cm wide. They are double-toothed. The petiole is 3 to 4 cm long. The upper surface of the blade is dark green and the lower surface is slightly lighter.

The foliage is light green in the spring, dark green beginning in mid-summer, and turns yellow, orange or scarlet red in the fall. The reddest trees are those that have received more sun exposure; there is also genetic variation from specimen to specimen.

Before the leaves appear, this maple is covered with tiny white or yellowish fragrant flowers, which is uncommon among maples. They are grouped in panicles of 3 cm in diameter.

PROPAGATION

Seedlings: The samaras mature from mid-August to mid-September and can be harvested during the entire fall period. Since the embryo envelope is impermeable and the embryo is dormant, the seeds must be stratified for at least 180 days in moist sand at 4°C or 5°C or undergo slight scarification followed by stratification for 90 days.

The seeds can be kept for 2 1/2 years in sealed containers, stored at 4°C or 5°C without loss of viability.

Under natural conditions, germination of this species will generally take two years, unless the seeds are sown early in the fall; warm temperatures for one or two months should result in faster bacterial and fungal action on the impermeable pericarp.

Propagation by cuttings: According to Coggeshall (1957), cuttings taken from three-year-old parent plants treated with Hormodin #3[®] resulted in a rooting rate of 92% after three weeks; untreated cuttings also yielded good rooting rates.

Chapman (1958) states that a high success rate can be obtained during several months of the year, with the optimum being around mid-June.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Morden, Manitoba

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

Propagation technique: The samaras were collected in the fall of 1982 and sown outside on November 10. Some of the seeds germinated in May 1983. The seedlings were potted in small pots in the fall and then grown in frames. In the spring of 1985, they were wrapped and shipped to the evaluation sites. The winter survival rate was 82%.

Inclusion in test network: Young seedlings 20 to 25 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality was very low and only one seedling died in four of the nine sites.

Most of the damage was slight and was observed on the stem tips.

Mechanical breakage was more severe in region 3.

Region 1

At Sainte-Clotilde, the seedlings were affected only during the winter of 86-87 and one seedling died.

At the L'Assomption site on clay, the mortality and the damage on the previous year's shoot appeared only following the winter of 87-88 and only on one or two seedlings. At the sandy site, mild frost damage on the stem tips was observed on 60% to 90% of the seedlings following the second and third winters.

At Sainte-Anne-de-Bellevue, slight damage occurred every year.

Region 2

There was very little damage to the seedlings at Deschambault and La Pocatière after the first and last winters, while at Sainte-Foy, the damage was less frequent during the last two winters.

Mortality was low and was not related to the severity of the winters.

Region 3

No mortality was observed in this region, but mechanical damage was more severe: at Normandin, mechanical damage occurred following the first and last winters on approximately 25% of the seedlings, and was observed in three out of five winters at Kapuskasing on 50% to 67% of the seedlings.

The damage observed was due mainly to mild frost on the tips of the stems.

Acer Ginnala Maxim.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.79 m R2 = 2.27 m R3 = 1.78 m

Categories

The average height of the trees after five years varied from one site to another:

3.51 m and + : Sainte-Clotilde
 3.01 - 3.50 m: Sainte-Anne-de-Bellevue
 2.51 - 3.00 m: La Pocatière
 2.01 - 2.50 m: L'Assomption on sand, Deschambault, Sainte-Foy and Normandin
 1.51 - 2.00 m: L'Assomption on clay and Kapuskasing

The trees at Sainte-Clotilde and Sainte-Anne-de-Bellevue were clearly taller, while those at L'Assomption on clay and Kapuskasing were clearly smaller.

Effect of pruning

Pruning was greater at the L'Assomption on clay, Sainte-Foy and Normandin sites. At the first two sites, it was necessary particularly in the first two or three years, while at Normandin, it was necessary every year.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 1.64 m R2 = 1.58 m R3 = 1.36 m

The regional averages reflect very great heterogeneity among sites in the same region, which yields a similar average for regions 1 and 2.

Categories

The average width of the trees after five years varied from one site to another:

1.76 - 2.00 m: La Pocatière, Sainte-Clotilde and Sainte-Anne-de-Bellevue
 1.51 - 1.75 m: L'Assomption on sand and Sainte-Foy
 1.26 - 1.50 m: Normandin, Kapuskasing and L'Assomption on clay
 1.01 - 1.25 m: Deschambault

Minimum growth was observed at Sainte-Clotilde the last year. The seedlings at Sainte-Foy had attained half their final width by the second year.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

To obtain trees with a height of more than 1 m, it took three years at all the sites, except at Kapuskasing and at the two sites in L'Assomption, where a fourth year was necessary.

However, it should be pointed out that by the end of the second year of growth, 30% to 40% of the trees at Sainte-Foy, Normandin and Sainte-Clotilde had attained this height.

The production of this species can be recommended throughout Quebec, since it supports all soil types. However, it is more competitive at the sites along the south shore of Montreal as well as at La Pocatière, where the climate is well suited to this species.

Use

The test demonstrated that zone 2 established by Sherk and Buckley is suited to the potential of this species, since in the northernmost test zones, the damage was limited to the tips of the previous year's shoots.

It is recommended that this species be protected in high snowfall regions, since mechanical breakage associated with precipitation caused damage at Normandin and at Kapuskasing.

BIBLIOGRAPHICAL REFERENCES

2, 3, 15, 19, 21, 27, 29, 43, 51, 57, 60, 71, 86, 99, 103

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Table 1: Frequency of winter damage observed on *Acer ginnala* from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	61	34	3			2				39	
L'Assomption-sand	69	31								31	
Ste-Anne-de-Bellevue	4	95						1		96	
Sainte-Clotilde	78	20				2				22	
REGION 2											
Deschambault	55	40				2		3		45	
Sainte-Foy	46	52					2			54	
La Pocatière	42	55				3				58	
REGION 3											
Normandin	27	60	2						11	73	
Kapuskasing	35	38	2						25	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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 6, 7, and 11 occurred in this species.

Table 2: Breakdown of *Acer ginnala* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	100	57	8	8	0	86	43	8	0	0	52	5	0	0	0	62	10	0	0	0					
51-75	0	38	8	0	0	14	52	25	27	0	48	33	8	0	0	38	35	8	0	0					
76-100	0	5	42	17	0	0	5	17	0	9	0	33	0	0	0	0	55	8	0	0					
101-150	0	0	42	50	17	0	0	50	36	9	0	29	17	8	0	0	0	17	8	8					
151-200	0	0	0	17	8	0	0	0	37	18	0	0	25	0	0	0	0	59	9	0					
201-300	0	0	0	8	67	0	0	0	0	64	0	0	50	33	18	0	0	8	83	8					
301-400	0	0	0	0	8	-	-	-	-	-	0	0	0	59	73	0	0	0	0	84					
401-500	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	81	14	0	0	9	71	19	0	0	0	90	14	0	0	0	62	0	0	0	0	80	30	17	8	8
51-75	19	24	0	0	0	24	43	17	0	0	10	48	18	0	0	38	19	0	0	8	20	45	0	8	0
76-100	0	33	16	9	0	5	28	25	17	9	0	38	9	9	0	0	33	42	0	0	0	25	58	0	8
101-150	0	29	42	25	0	0	10	42	25	27	0	0	64	9	10	0	48	50	17	25	0	0	25	67	25
151-200	0	0	42	33	25	0	0	16	33	0	0	0	9	18	0	0	0	8	75	0	0	0	0	17	42
201-300	0	0	0	33	58	0	0	0	25	55	0	0	0	64	90	0	0	0	8	67	0	0	0	0	17
301-400	0	0	0	0	8	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401-500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Acer negundo (L.)

See colour plate

Family	:	Aceracea
English name	:	Box-elder, ashleaf maple
French name	:	Érable à Giguère
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree of irregular growth habit can grow to a height of 12 to 15 m and attain a trunk diameter of 1 m.

Standing alone, the trunk divides near the ground into several large, spreading and rather twisted branches, which branch irregularly to form a broad asymmetrical crown. When the species grows among other trees, the trunk is much longer and the crown is less voluminous than on open ground.

The bark is light grey and smooth, becoming darker with age, marked by firm, narrow ridges. The colour of the young stems ranges from light green to brownish-red; they are glabrous and covered with a whitish bloom that rubs off easily.

The upper surface of the leaves is green, and the lower surface is greyish-green and slightly pubescent. The leaves are composed of three to five leaflets and can reach a length of 5 to 15 cm. They have long petioles and are sometimes shallowly toothed. The terminal leaflet is often three-lobed. The leaves are very similar to those of the white ash. The foliage turns greenish-yellow in the fall.

This species is dioecious. The male trees present small flowers borne on frail stalks in fairly dense glomerules, and the female trees bear flowers arranged in hanging bunches. Flowering takes place before leaf development and pollination is by the wind.

The samaras, which have short wings set close together, are glabrous, approximately 3 cm long and are often sterile (no embryo). They mature in September or October. Usually numerous, they stay on the tree during

winter and attract birds. They are disseminated by wind or water.

ORIGIN AND DISTRIBUTION

This species originates in western North America and Ontario; it ranges northwest across Manitoba and southward as far as Florida, Texas and California. It is generally found along lakes and on the shores of rivers and streams. It has been cultivated in North America since 1688.

John Bannister, a missionary who came to North America, gathered the first seeds of *Acer negundo* in Virginia and sent them to England in the early 1700s. At that time, the species was called *Negundo fraxinifolium*.

USE

Ornamental: The ashleaf maple is used to create temporary windbreaks because its very rapid growth allows for the establishment of other slower-growing species. It can be used standing alone for its knotty and crooked trunk. It sends out a lot of suckers and its wood is brittle.

It is a good candidate for naturalization. This maple develops buds and leaves until late in the season: the terminal buds often abort and the lateral buds continue their development during the following season. This is the main reason for its irregular growth habit in our climate.

On the Prairies, it is used as a street tree for its rapid growth, its vigour and its adaptation to the harsh climate.

Economical: The wood is used to make boxes and for construction.

REQUIREMENTS

The ashleaf maple needs a lot of sun, grows very rapidly and transplants easily.

It adapts well to poor, wet habitats and to dry soil and cold climates.

It is usually short-lived and can survive periods of flooding. However, sites exposed to high winds should be avoided.

PATHOLOGY

This species is susceptible to certain cankers (*Nectria cinnabarrina*) and to anthracnose (*Discula* spp.), and is often infested by aphids. Its wood is weak and often breaks, creating routes for attack insects.

PROPAGATION

Seedlings: Prior to stratification for 90 days at 4°C or 5°C, it is recommended that the samaras be immersed in cold running water for two weeks to break the pericarp.

Some believe that the seeds should be harvested in late fall and sown immediately, while others are of the opinion that they can be kept in sealed containers, stored at 5°C for 18 months without loss of viability.

Propagation by cuttings: Semi-hard cuttings can be made by using rooting powder; the rooting rate is reportedly about 80%.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Morden, Manitoba

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

Propagation technique: The seeds were sown in frames on November 10, 1982. They germinated in May 1983 and the seedlings were grown in frames until July. They were transplanted to small pots and cultivated until the spring of 1985. The winter survival rate was 99%.

Inclusion in test network: Young seedlings 20 to 25 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

This species suffered very little winter damage.

Region 1

No trees suffered damage in this region, with the exception of those at Sainte-Anne-de-Bellevue, where slight damage was observed in the last four years.

Region 2

At Sainte-Foy and at La Pocatière, some of the trees suffered mild frost damage; this damage occurred in the second and third winters only.

Region 3

Only one seedling at the Normandin site was affected on the trunk during one winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 5.61 m R2 = 5.38 m R3 = 3.56 m

Categories

The average height of the trees after five years varied from one site to another:

6.01 m and + : Sainte-Clotilde
 5.01 - 6.00 m: Deschambault, Sainte-Foy, Sainte-Anne-de-Bellevue and L'Assomption on sand
 4.01 - 5.00 m: Normandin, L'Assomption on clay and La Pocatière
 2.51 - 3.00 m: Kapuskasing

The height of the trees increased year after year at all the sites. Regions 1 and 2 were comparable. The L'Assomption on clay and Kapuskasing sites brought down their respective regional averages.

Effect of pruning

This species demands very severe pruning for shaping and must be protected from wind which could accentuate its deformation.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 104 mm R2 = 90 mm R3 = 61 mm

Acer negundo (L.)

The trunk diameter appears to be related to favourable weather conditions, since the trees in region 1 were larger than those in region 2 and the latter were also larger than those in region 3. The trees at the Kapuskasing site brought down their regional average.

Categories

The average diameter of the trees after five years varied from one site to another:

101 mm and +:	L'Assomption on sand, Sainte-Clotilde and L'Assomption on clay
91 - 100 mm:	Sainte-Anne-de-Bellevue and Sainte-Foy
71 - 90 mm:	Deschambault, La Pocatière and Normandin
61 - 70 mm:	—
51 - 60 mm:	—
41 - 50 mm:	Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

It took only two years for 76% to 80% of the trees at Sainte-Clotilde and at Sainte-Anne-de-Bellevue to reach a diameter of 20 to 40 mm, and for those at Sainte-Foy and Deschambault to reach a diameter of 20 to 30 mm. A third year was necessary at the other sites to obtain trees of the same diameter (20 to 40 mm), and the percentage decreased to 58% at the Kapuskasing site for trees of 20 to 30 mm in diameter.

After five years, the trees in the Montreal region were slightly larger, having attained a trunk diameter of more than 100 mm.

After three years, more than 75% of the trees at Sainte-Clotilde, Sainte-Anne-de-Bellevue, Sainte-Foy and Deschambault had attained a height of between 2 and 3 m; this percentage fluctuated between 25% and 58% at

the other sites. Five years were needed at Kapuskasing and four years at all the other sites to obtain trees between 2 and 4 m in height.

The final height of the trees is largely determined by the first year's growth; the sites where this growth was the greatest were those which produced the tallest trees.

Use

Acer negundo is a highly resistant species. The results obtained demonstrate that zone 2, previously mentioned by Buckley, is suited to the potential of this species. However, the total lack of damage at Kapuskasing suggests that this species could grow without too much risk in the weather conditions of zone 1b. Although it is very hardy, this species has a certain number of disadvantages: the dieback requires considerable maintenance and frost damage to the terminal bud of the stems is responsible for the deformation of the tree's growth habit.

BIBLIOGRAPHICAL REFERENCES

2, 3, 12, 13, 27, 43, 50, 51, 56, 57, 60, 65, 67, 71, 86, 87, 95, 101, 103

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Table 1: Frequency of winter damage observed on *Acer negundo* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	100									0	
L'Assomption-sand	100									0	
Ste-Anne-de-Bellevue	58	42								42	
Sainte-Clotilde	96	4								4	
REGION 2											
Deschambault	100									0	
Sainte-Foy	73	27								27	
La Pocatière	76	22	2							24	
REGION 3											
Normandin	98						2			2	
Kapuskasing	100									0	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 6, 7, 8 and 11 occurred in this species

Table 2: Breakdown of *Acer negundo* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	100	14	0	0	0	85	5	0	0	0	67	0	0	0	0	76	0	0	0	0					
11-20	0	76	0	0	0	15	48	8	0	0	33	24	0	0	0	24	19	0	0	0					
21-30	0	10	50	0	0	0	47	0	0	0	0	52	8	0	0	0	76	0	0	0					
31-40	0	0	42	25	0	0	0	34	8	0	0	24	25	0	0	0	5	33	0	0					
41-50	0	0	8	34	17	0	0	50	25	8	0	0	42	25	0	0	0	67	8	0					
51-60	0	0	0	33	33	0	0	8	17	8	0	0	17	33	8	0	0	0	42	8					
61-70	0	0	0	0	8	0	0	0	42	17	0	0	8	17	34	0	0	0	50	17					
71-90	0	0	0	8	42	0	0	0	8	50	0	0	0	25	25	0	0	0	0	75					
91 and +	-	-	-	-	-	0	0	0	0	17	0	0	0	0	33	-	-	-	-	-					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	48	0	0	0	0	24	0	0	0	0	100	0	0	0	0	100	0	0	0	0	100	14	0	0	0
11-20	52	24	0	0	0	76	24	0	0	0	0	100	0	0	0	0	86	17	0	0	0	86	42	0	0
21-30	0	76	0	0	0	0	76	8	0	0	0	0	83	0	0	0	14	41	8	0	0	0	58	8	0
31-40	0	0	50	0	0	0	0	34	17	0	0	0	17	0	0	0	0	42	33	8	0	0	0	75	17
41-50	0	0	50	17	0	0	0	58	33	17	0	0	0	100	0	0	0	0	34	25	0	0	0	17	75
51-60	0	0	0	50	8	0	0	0	50	25	0	0	0	0	25	0	0	0	17	17	0	0	0	0	8
61-70	0	0	0	33	50	0	0	0	0	58	0	0	0	0	75	0	0	0	8	25	-	-	-	-	-
71-90	0	0	0	0	34	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-
91 and +	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Acer negundo* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	100	62	0	0	0	100	29	8	0	0	100	24	0	0	0	100	19	0	0	0
101-200	0	38	75	17	0	0	71	50	17	8	0	38	25	0	0	0	76	25	0	0
201-300	0	0	25	25	25	0	0	42	58	0	0	38	50	58	17	0	5	67	8	0
301-400	0	0	0	58	42	0	0	0	25	75	0	0	17	25	17	0	0	8	92	42
401-500	0	0	0	0	33	0	0	0	0	17	0	0	8	17	50	0	0	0	0	42
501-600	-	-	-	-	-	-	-	-	-	-	0	0	0	0	16	0	0	0	0	16

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	100	0	0	0	0	100	19	0	0	0	100	10	0	0	0	100	5	0	0	0	100	100	8	0	0
101-200	0	95	8	0	0	0	81	17	0	0	0	90	50	8	0	0	90	42	0	0	0	0	92	75	0
201-300	0	5	67	0	0	0	0	83	17	0	0	0	50	50	0	0	5	50	50	0	0	0	0	25	92
301-400	0	0	25	100	50	0	0	0	83	50	0	0	0	42	58	0	0	8	50	58	0	0	0	0	8
401-500	0	0	0	0	50	0	0	0	0	50	0	0	0	0	42	0	0	0	0	33	-	-	-	-	-
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-

Acer rubrum L.

See colour plate

Family	:	Aceracea
English name	:	Red maple, swamp maple
French name	:	Érable rouge or plaine rouge
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This indigenous species can reach a height of 12 m in Quebec. When it grows on open ground, the red maple is composed of large ascending branches which begin near the ground. These, in turn, bear highly diverse secondary branches, thereby forming a dense and deep top. Standing alone, its crown is rounded and its width can reach 2 to 3 m. Its trunk is very straight.

The bark, grey and rough, cracks and scales over the years. The scales are fastened at the centre and loose at the ends.

The young branches are red, glabrous and glossy, with numerous lenticels. The lateral branches develop slowly.

The opposite leaves are palmately lobed (three to five lobes) with shallow pointed sinuses and are 6 to 10 cm wide by 10 cm long. The blade has small sharp, irregular double teeth. The upper surface of the leaves is dark green and the lower surface is whitish. Both surfaces are glabrous. The foliage becomes red in the fall and intensity varies from one specimen to another.

The globular flower buds have red scales and are clearly visible beginning in the fall. The leaf buds are red, obtuse (the length is less than twice the width), smooth, glossy and generally have four scales.

The red flowers, in dense corymbs, appear before the leaves. The male and female flowers are borne on different trees or sometimes on the same tree.

The root system is shallow and spreading.

The samaras are U-shaped and reach maturity in early June. The wings form an angle of approximately 60 degrees. The seeds are bulbous.

ORIGIN AND DISTRIBUTION

The genus name "*Acer*" means both "arc" and "hard". The red maple owes its species name to the colour of its foliage and its inflorescences. This indigenous species is found in the eastern United States, in southern Quebec and Newfoundland and ranges as far south as the Gulf of Mexico and Florida. In Quebec, it can be found throughout the Deciduous Forest Region, the Great Lakes-St. Lawrence Forest Region as well as in the Acadian Forest Region. It has been known since 1656.

USE

Ornamental: Its colourful fall foliage and its abundant flowers are valuable ornamental attractions. It can be used in parks.

Wood use: Its wood is used for firewood and lumber but is less sought after than that of the sugar maple. It is light brown, heavy, fairly hard and quite resistant.

Culinary: This species is also tapped for maple syrup, but the syrup is darker and has a stronger taste.

REQUIREMENTS

This maple usually grows in cool, moist and even swampy habitats. However, it can be found on dry, rocky soils. It adapts to cool, well-drained silty clay soils. It tolerates limestone soils but prefers soils with a neutral pH.

This species can be transplanted relatively easily. It does not adapt well to urban conditions.

PATHOLOGY

The eutypella canker (*Eutypella parasitica*) is a fungal disease which can affect all maples in our forests. However, the Norway maple and its many cultivars seem to be the preferred host of this fungus.

PROPAGATION

Seedlings: The seeds germinate a few days after falling to the ground.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were harvested on June 1, 1984 from a remarkable 40 year-old parent plant. They were sown on June 5 in a frame and germination was very uniform. The seedlings were dug up on October 25, 1985 and heeled in until they were shipped in the spring of 1986.

Inclusion in test network: Young seedlings 30 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

The damage was much more severe in region 3, in those areas where the height of the trees exceeded the snow cover. Furthermore, 33% of the seedlings died following transplantation to the Normandin site.

Region 1

At L'Assomption on clay, more than 90% of the seedlings did not suffer any damage annually; two seedlings were affected by rodents during the second winter, one seedling suffered frost damage on the previous year's shoot the third winter and one seedling died the last winter.

At the other two sites, all the seedlings exhibited frost damage on the shoot tip or on the entire previous year's shoot the first winter. At L'Assomption on sand, 33% of the seedlings froze down to the snow and ground level or on the previous year's shoot the third winter, while at Sainte-Clotilde all the seedlings froze, to various degrees.

Region 2

At Sainte-Foy, the seedlings were particularly affected the first three winters; 95% suffered frost damage on the shoot tip the first winter and 92% of the seedlings were affected on the entire previous year's shoot the two following winters. Thereafter, 75% and 84% of the seedlings did not suffer any damage.

At Deschambault, the main damage was the frost damage to the shoot tip and the percentage of seedlings affected decreased over the years. Moreover, 36% and 9% of the seedlings exhibited frost damage on the previous year's shoot during the third and fourth winters.

At La Pocatière, the percentage of undamaged seedlings was 62%, 70% and 42% the first, second and fifth winters. Very severe frost damage affected 35% of the seedlings the first winter; 92% and 83% of the seedlings exhibited frost damage on the previous year's shoot during the third and fourth winters respectively.

Region 3

At Normandin, almost all the seedlings suffered frost damage each year; 80% of the seedlings suffered frost damage on the shoot tip during the first two winters and more than 55% of the seedlings suffered damage on the entire previous year's shoot the following winters.

At Kapuskasing, little damage was observed following the second and third winters. However, mechanical breakage occurred on 33% of the seedlings the fourth winter and frost damage down to the level of snow cover on 42% of the seedlings. The following winter, 73% of the seedlings suffered frost damage on the shoot tip.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.63 m R2 = 2.75 m R3 = 1.90 m

Categories

The average height of the trees after five years varied from one station to another:

3.01 - 4.00 m: Sainte-Clotilde, L'Assomption on sand and Deschambault
2.01 - 3.00 m: Sainte-Foy and L'Assomption on clay

Acer rubrum L.

1.01 - 2.00 m: Normandin
1.00 m and - : La Pocatière and Kapuskasing

The sites in the Montreal region had better growth. Growth in heavy and clay soils was clearly poorer.

Effect of pruning

Pruning resulted in the elimination of 50% of the previous year's shoot at the Sainte-Foy site following the second and third winters; furthermore, five seedlings were cut back to the ground level the last year in order to obtain a straight and well-shaped trunk. Pruning was also extensive at the other two sites: 50% and 30% respectively for the last two years at La Pocatière and every year at Normandin.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 44 mm R2 = 35 mm R3 = 20 mm

The La Pocatière and Kapuskasing sites substantially reduced their respective regional averages.

Categories

The average diameter of the trees after five years varied from one station to another:

46 - 55 mm: Sainte-Clotilde, Sainte-Foy and L'Assomption on sand
36 - 45 mm: Deschambault
26 - 35 mm: L'Assomption on clay and Normandin
15 - 25 mm: Kapuskasing and La Pocatière

Growth was poorer at the sites with clay soil.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined diameter or height.

Production

Growth was faster in the Montreal region as well as at Sainte-Foy; 92% of the seedlings at Sainte-Clotilde had attained a height ranging from 2 to 4 m after the third year, while an additional year was necessary at L'Assomption on sand and at Sainte-Foy. The diameter of the trees followed the same growth curve.

However, commercial production of young seedlings of this species appears to be difficult in the growing conditions generally encountered in Quebec nurseries. Considerable winter damage appeared on the young shoots leading to considerable growth losses at several sites. This indigenous species normally grows in often waterlogged soils where the mineralization of organic matter is low.

This species therefore requires little nitrogen; the nitrogenous fertilizers applied in this test may have been too much, fostering excessive growth and delaying the cold hardening of the new shoots.

Before issuing production recommendations for this species, we feel it is necessary to continue our research in order to determine the most favourable growing conditions for it.

Use

The results do not enable us to accurately determine the zone rating of this species since it did not perform well in the test conditions. However, this indigenous species normally grows as far north as zone 3.

Moreover, because of the large natural distribution of this species, the origin of the seeds may have a significant influence on the hardiness of the seedlings.

BIBLIOGRAPHICAL REFERENCES

4, 6, 12, 13, 16, 47, 51, 58, 65, 76, 101

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Table 1: Frequency of winter damage observed on *Acer rubrum* from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	74	12	10	2	2					26	
L'Assomption-sand	94		2			2			2	6	
Sainte-Clotilde	59	30	5			3	3			41	
REGION 2											
Deschambault	33	28	39							67	
Sainte-Foy	45	45	9					1		55	
La Pocatière	34	22	37	2		1	4			66	
REGION 3											
Normandin	14	51	35							86	
Kapuskasing	54	29		8		2	1	6		46	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

Table 2: Breakdown of *Acer rubrum* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	95	34	0	0	0	100	52	0	0	0	100	5	0	0	0
101-200	5	62	100	25	8	0	48	100	67	27	0	80	8	10	0
201-300	0	4	0	58	17	0	0	0	33	45	0	15	58	27	18
301-400	0	0	0	17	58	0	0	0	0	28	0	0	34	55	27
401-500	0	0	0	0	17	-	-	-	-	-	0	0	0	8	45
501-600	-	-	-	-	-	-	-	-	-	-	0	0	0	0	10
Height (cm)	REGION 2														
	Sainte-Foy					Deschambault					La Pocatière				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	58	5	0	0	16	100	6	0	0	0	100	100	58	67	75
101-200	42	32	0	17	25	0	94	50	17	17	0	0	42	33	25
201-300	0	63	100	67	8	0	0	50	58	8	-	-	-	-	-
301-400	0	0	0	16	34	0	0	0	25	75	-	-	-	-	-
401-500	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Height (cm)	REGION 3														
	Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	100	50	0	0	0	100	100	100	100	90	100	100	100	100	90
101-200	0	50	73	55	55	0	0	0	0	10	0	0	0	0	10
201-300	0	0	27	45	45	-	-	-	-	-	-	-	-	-	-
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401-500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Acer rubrum* plants by marketable trunk diameter category from 1986 to 1990

Trunk diameter (mm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	76	17	0	0	100	95	67	17	9	100	35	8	0	0
21-40	0	24	83	59	42	0	5	33	83	72	0	65	83	18	18
41-60	0	0	0	41	50	0	0	0	0	19	0	0	9	82	36
61-80	0	0	0	0	8	-	-	-	-	-	0	0	0	0	46

Trunk diameter (mm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	11	0	0	0	100	95	25	8	0	100	100	100	100	83	100	100	73	36	9	100	100	100	100	100
21-40	0	89	100	75	17	0	5	75	84	34	0	0	0	0	17	0	0	27	64	91	-	-	-	-	-
41-60	0	0	0	25	75	0	0	0	8	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61-80	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Acer saccharinum L. (C)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the first series of descriptive reports (publication 02-9227).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Terrebonne, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were sown in June 1983 in a frame. The seedlings were dug up in the fall of 1984 and heeled in until they were shipped in May 1985.

Inclusion in test network: Seedlings 30 to 40 cm high and 8 mm in diameter were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

No mortality occurred during the five years of testing, for all the sites.

Every year, 40% to 75% of the seedlings suffered slight damage on the tip of the previous year's shoot; the second winter was the harshest.

Region 1

Damage was limited to frost damage on the tip of the previous year's shoot. This region had the highest percentage of undamaged seedlings.

Twenty percent of the seedlings at Sainte-Anne-de-Bellevue suffered damage caused by rodents during the first winter.

Region 2

This species suffered slight damage four winters out of five at Sainte-Foy.

At La Pocatière, damage was either frost damage on a large section of the previous year's shoot or frost damage on the tip only.

At Deschambault, only 10% to 25% of the seedlings were affected, two winters out of five, by frost damage on the tip of the previous year's shoot.

Region 3

In the first and last winters, more than 90% of the seedlings suffered no damage at Normandin and at Kapuskasing.

Damage was limited to frost damage on the tip of the previous year's shoot, except at Kapuskasing, in 1988, where all the seedlings suffered damage on the entire previous year's shoot.

Growth in height

After five years, the average height for each region was:

R1 = 5.22 m R2 = 4.58 m R3 = 3.32 m

Every year, the height of the trees at Sainte-Clotilde was greater than that attained at the other sites; the height of the trees at La Pocatière, Normandin and Kapuskasing was lower.

Categories

The average height of the trees after five years varied significantly from one site to another:

5.51 m and + : Sainte-Clotilde
 4.51 - 5.50 m: Sainte-Anne-de-Bellevue,
 L'Assomption on sand, Deschambault
 and Sainte-Foy
 4.01 - 4.50 m: L'Assomption on clay and Normandin
 3.51 - 4.00 m: La Pocatière
 2.01 - 2.50 m: Kapuskasing

Effect of pruning

Pruning, carried out every spring, represented more than 50% of the previous year's shoot in 1985, 1986 and

1987. It was less than 30% in 1988. Pruning was more severe in regions 2 and 3.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 77 mm R2 = 66 mm R3 = 48 mm

Every year, the diameter of the trees at the end of the season was smaller at the La Pocatière, Normandin and Kapuskasing sites.

Compared to the other sites, the increase in trunk diameter was very small at La Pocatière and at Normandin the first year, and very small at Kapuskasing the first two years.

Categories

The average diameter of the trees after five years varied significantly from one site to another:

81 - 90 mm: L'Assomption on sand and Sainte-Clotilde
 71 - 80 mm: Sainte-Anne-de-Bellevue, Sainte-Foy and Deschambault
 61 - 70 mm: L'Assomption on clay
 51 - 60 mm: Normandin and La Pocatière
 41 - 50 mm: Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

It may be advisable to regionalize the production of silver maples, since the diameters obtained after three years varied significantly from one region to another: in region 1, more than 75% of the trees in production attained a diameter ranging from 41 to 60 mm and a height of more than 3 m. However, there were differences among the sites in this region: the diameter of the trees at Sainte-Clotilde was slightly greater than that of the trees at the other sites in the region, while the diameter of those at L'Assomption on clay was lower.

In region 2, it took an additional year to obtain a similar percentage of trees of the same diameter. Furthermore, the production was less regular from one site to another since the trees at La Pocatière were slightly smaller, and those at Sainte-Foy were slightly larger than those at Deschambault.

In region 3, there would be no economic advantage to producing this species, since even after five years, the trees were still smaller and the production was less uniform.

Furthermore, the growth of the trees on clay soil was clearly poorer.

Use

This clone suffered much less winter damage than the one used in the 1984 planting, even though it also came from the Terrebonne nursery. There are many origins for this species. The hardiness of the plants obtained from the clone selected for this test is similar to that established by Sherk and Buckley (2b), although fairly severe damage can occasionally occur on young trees. The seedlings from this clone can be used throughout Quebec.

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Table 1: Frequency of winter damage observed on *Acer saccharinum* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage							Cumulative damage	
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	99	1								1
L'Assomption-sand	96	4								4
Ste-Anne-de-Bellevue	21	75							4	79
Sainte-Clotilde	79	21								21
REGION 2										
Deschambault	87	9						2	2	13
Sainte-Foy	42	56	2							58
La Pocatière	35	42	23							65
REGION 3										
Normandin	47	53								53
Kapuskasing	39	41	20							61

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 5, 6, 7, 8 and 9 occurred in this species.

Table 2: Breakdown of *Acer saccharinum* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-30	100	76	0	0	0	100	80	0	0	0	100	57	0	0	0	100	57	0	0	0					
31-40	0	24	25	0	0	0	20	42	0	0	0	38	16	0	0	0	43	25	0	0					
41-50	0	0	68	0	0	0	0	50	17	0	0	5	17	8	8	0	0	42	17	0					
51-60	0	0	7	42	0	0	0	8	50	8	0	0	50	25	0	0	0	33	25	8					
61-70	0	0	0	33	9	0	0	0	25	59	0	0	17	0	17	0	0	0	33	34					
71-80	0	0	0	25	33	0	0	0	8	25	0	0	0	42	8	0	0	0	25	25					
81 and +	0	0	0	0	58	0	0	0	0	8	0	0	0	25	67	0	0	0	0	33					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-30	100	100	0	0	0	100	48	0	0	0	100	100	100	0	0	100	100	92	0	0	100	100	100	8	0
31-40	0	0	50	0	0	0	52	58	0	0	0	0	0	83	8	0	0	8	50	0	0	0	0	92	42
41-50	0	0	50	17	0	0	0	34	8	0	0	0	0	17	34	0	0	0	42	33	0	0	0	0	58
51-60	0	0	0	58	0	0	0	8	42	0	0	0	0	0	50	0	0	0	8	50	-	-	-	-	-
61-70	0	0	0	25	50	0	0	0	42	33	0	0	0	0	8	0	0	0	0	9	-	-	-	-	-
71-80	0	0	0	0	42	0	0	0	8	42	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
81 and +	0	0	0	0	8	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Acer saccharinum* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-200	100	62	0	0	0	100	55	0	0	0	100	19	0	0	0	100	62	0	0	0
201-250	0	38	25	0	0	0	45	33	0	0	0	19	0	0	0	0	33	0	0	0
251-300	0	0	33	0	0	0	0	33	8	0	0	29	8	0	0	0	5	42	0	0
301-400	0	0	42	50	0	0	0	34	75	25	0	33	42	8	8	0	0	50	0	0
401-500	0	0	0	50	17	0	0	0	17	67	0	0	50	92	8	0	0	8	100	0
501-600	0	0	0	0	83	0	0	0	0	8	0	0	0	0	25	0	0	0	0	100
601 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	59	-	-	-	-	-

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-200	100	29	0	0	0	100	43	0	0	0	100	95	42	8	0	100	81	0	0	0	100	100	100	33	8
201-250	0	71	0	0	0	0	33	0	0	0	0	5	58	0	8	0	19	67	0	0	0	0	0	67	33
251-300	0	0	42	0	0	0	24	50	0	0	0	0	0	42	0	0	0	33	0	0	0	0	0	0	59
301-400	0	0	58	75	17	0	0	42	58	0	0	0	0	50	42	0	0	0	92	33	-	-	-	-	-
401-500	0	0	0	25	75	0	0	8	25	17	0	0	0	0	50	0	0	0	8	67	-	-	-	-	-
501-600	0	0	0	0	8	0	0	0	17	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
601 and +	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Acer saccharinum L. (C)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the first series of descriptive reports (publication 02-9227).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Street planting, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were harvested on May 29, 1985 from parent plants approximately 25 years old. They were sown on June 4 in a frame and germination was uniform. The seedlings were cultivated in the frame and dug up in the fall. They were heeled in until they were shipped in the spring of 1986.

Inclusion in test network: Young seedlings 35 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table I). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Very few seedlings died during testing.

Region 1

Frost damage was slight at the three sites in region 1.

At the L'Assomption site on sand, the damage on the previous year's shoot occurred during the first winter. Frost damage on the shoot tip occurred the first four winters.

At the L'Assomption site on clay, frost damage on the shoot tip occurred during the first and third winters on 100% and 33% of the seedlings. Two seedlings were damaged by rodents the second winter but this had no effect on the growth of these seedlings.

At the Sainte-Clotilde site, frost damage on the shoot tip occurred on all the seedlings the first winter.

Region 2

At the Sainte-Foy site, frost damage on the shoot tip occurred on 30% to 100% of the seedlings the first four winters. Frost damage on the previous year's shoot was evident on 40% to 50% of the seedlings the second and third winters and on 10% of the seedlings the last two winters. One seedling died the third winter and another the fourth.

At the Deschambault site, all the seedlings exhibited signs of frost damage on the previous year's shoot during the second winter; 30% to 60% of the seedlings suffered frost damage on the shoot tip the last three winters.

At La Pocatière, all the seedlings were affected by frost damage on the shoot tip or by frost damage on the previous year's shoot every winter.

Region 3

At Normandin, the behaviour was similar to that of the seedlings at La Pocatière with, in addition, the death of 33% of seedlings during the fourth winter.

At Kapuskasing, more than half of the seedlings died the year of planting. Frost damage on the shoot tip was observed following the first two and last two winters. Furthermore, all the seedlings were damaged on the previous year's shoot the third winter and 30% the last winter. Frost damage down to the ground level or level of snow cover occurred respectively the first and fourth winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 5.53 m R2 = 5.31 m R3 = 2.96 m

The seedlings produced at the sites in region 3 were clearly smaller. Those at L'Assomption on clay and at La Pocatière brought down their respective regional average.

Categories

The average height of the trees after five years varied from one station to another:

- 6.01 m and + : Sainte-Clotilde
- 5.01 - 6.00 m : Deschambault, Sainte-Foy and L'Assomption on sand
- 4.01 - 5.00 m : L'Assomption on clay
- 3.01 - 4.00 m : La Pocatière and Normandin
- 3.00 m and - : Kapuskasing

Effect of pruning

Pruning carried out every spring represented a reduction of 30% to 50% of the previous year's shoot at the Normandin and Kapuskasing sites. There was virtually no pruning at the other sites, with a few exceptions.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 88 mm R2 = 75 mm R3 = 45 mm

Seedlings from the same region were relatively uniform from one site to another.

Categories

The average diameter of the trees after five years varied from one station to another:

- 101 mm and + : Sainte-Clotilde
- 81 - 100 mm : Deschambault, Sainte-Foy and L'Assomption on sand
- 61 - 80 mm : L'Assomption on clay
- 41 - 60 mm : La Pocatière, Normandin and Kapuskasing

The diameter of the trees at the end of the season was smaller at the sites with clay soil.

Compared to the other sites, the increase in trunk diameter was very small at Normandin, La Pocatière and Kapuskasing the first two years.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery

growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined diameter or height.

Production

It may be advisable to regionalize the production of silver maples, since the diameters obtained after three years varied significantly from one site to another. In fact, at Sainte-Clotilde, all the seedlings had attained a diameter of more than 51 mm and a height of more than 4.0 m. In the two sites at L'Assomption and at the Sainte-Foy site, 40% to 67% of the seedlings had attained a comparable diameter and a height of more than 3.0 m. In region 2, the seedlings at Deschambault had attained a height comparable to those at Sainte-Foy but their diameter was smaller.

In region 3, there would be no economic advantage to producing this species, since even after five years, the trees were still smaller and the production was less uniform. Furthermore, the growth of the trees on clay soil was clearly poorer.

Use

The seedlings from this seed origin exhibited more damage than those used in the 1985 planting. This species has numerous clones and the plants in the test were not as hardy as the plants Sherk and Buckley used to assign a zone rating of 2b to this species. Because of the severe damage occasionally observed on the young trees in the region 3 sites, we cannot recommend this plant in zone 2.

Another origin will be tested during the coming years in order to gain a better understanding of the behaviour of the plants based on their origin.

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Table 1: Frequency of winter damage observed on *Acer saccharinum* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	71	27							2		29
L'Assomption-sand	34	59	7								66
Sainte-Clotilde	78	20						2			22
REGION 2											
Deschambault	42	31	25				2				58
Sainte-Foy	29	44	23			4					71
La Pocatière	3	59	38								97
REGION 3											
Normandin	0	52	41			7					100
Kapuskasing	0	66	26	6	2						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 splitting |
| 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 types 9 and 14 occurred for this species.

Table 2: Breakdown of *Acer saccharinum* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-200	100	0	0	8	0	100	10	0	0	0	100	0	0	0	0										
201-300	0	72	0	9	8	0	81	17	8	0	0	0	0	0	0										
301-400	0	28	83	8	0	0	9	75	17	8	0	76	0	8	0										
401-500	0	0	17	58	34	0	0	8	75	58	0	24	100	0	8										
501-600	0	0	0	17	33	0	0	0	0	34	0	0	0	17	17										
601-700	0	0	0	0	25	-	-	-	-	-	0	0	0	75	75										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-200	100	0	17	0	0	100	0	0	0	0	100	100	25	0	0	100	38	17	8	0	100	100	57	71	14
201-300	0	33	0	0	10	0	71	0	0	0	0	0	75	75	8	0	62	58	25	37	0	0	43	29	86
301-400	0	67	67	45	20	0	29	83	8	0	0	0	0	25	92	0	0	25	67	38	-	-	-	-	-
401-500	0	0	16	55	10	0	0	17	50	16	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-
501-600	0	0	0	0	60	0	0	0	42	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
601-700	-	-	-	-	-	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Acer saccharinum* plants by marketable trunk diameter category from 1986 to 1990

Trunk diameter (mm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	10	0	0	0	100	14	0	0	0	100	0	0	0	0
26-50	0	90	33	0	0	0	86	58	8	0	0	100	0	0	0
51-75	0	0	67	75	42	0	0	42	75	25	0	0	100	8	0
76-100	0	0	0	25	33	0	0	0	17	75	0	0	0	92	42
101-125	0	0	0	0	25	-	-	-	-	-	0	0	0	0	58

Trunk diameter (mm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	0	0	0	10	100	12	0	0	0	100	100	50	0	0	100	90	8	8	0	100	100	NA	28	0
26-50	0	100	33	9	0	0	88	67	0	0	0	0	50	100	58	0	10	92	83	63	0	0	NA	72	100
51-75	0	0	67	91	20	0	0	33	75	8	0	0	0	0	42	0	0	0	9	37	-	-	NA	-	-
76-100	0	0	0	0	70	0	0	0	25	58	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-
101-125	-	-	-	-	-	0	0	0	0	34	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-

Acer tataricum L.

See colour plate

Family	:	Aceracea
English name	:	Tatarian maple
French name	:	Érable de Tartarie
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This tree can reach a height of 10 m. It has a spreading growth habit and an oval crown. It can be cultivated in the form of a small, multi-stemmed tree.

The young reddish-brown stems are thin, glabrous, angular and dotted with numerous lenticels.

The opposite, simple, broadly ovate and elliptical leaves are 5 to 8 cm long. Their margin is irregular and double-toothed. The upper surface is light green. The leaves turn light red, orange or yellow in the fall. The pubescent veins on the underside of the young leaves become glabrous as they grow older. The petioles are bright red.

The overlapping buds are small, red-brown to dark brown, glabrous or slightly hairy.

The flowers appear in May and are greenish-white, fragrant but inconspicuous; they are borne on long peduncles and grouped into erect panicles.

The samaras are nearly 3 cm long and their wings are almost parallel. They turn different shades of red in the summer and become light brown at maturity. Fruit production is more abundant than in the case of *Acer Ginnala*.

ORIGIN AND DISTRIBUTION

Philip Miller discovered the Tatarian maple in Mongolia. The natural distribution range of the species covers western Asia and extends as far as Europe; it began to be cultivated around 1752.

USE

Ornamental: This species can be used standing alone or in clumps, as a free hedge, or as a street tree where space is limited. It is very interesting for its growth habit, its foliage and its red samaras in the summer. It is well suited to residential neighbourhoods and it is used in a similar way to *Acer Ginnala*.

Naturalization: It is also used as a stabilizing plant.

REQUIREMENTS

This maple prefers sunny sites as well as rich, deep soil. It adapts to several humidity and pH conditions; it tolerates dry and sandy sites as well as urban conditions. It can easily be transplanted by root ball.

It is faster growing than *Acer Ginnala* but it does not seem to be as hardy as the latter.

Fairly heaving pruning is necessary to obtain a single trunk and to prevent wind damage.

PATHOLOGY

This species is not susceptible to any serious diseases.

PROPAGATION

Seedlings: The samaras mature from mid-August to mid-September and can be gathered throughout the fall. Since the embryo envelope is impermeable and the embryo is dormant, the seeds must be stratified for 180 days or more in moist sand at 4°C or 5°C or undergo slight scarification followed by stratification for 90 days.

The seeds can be kept for 2 1/2 years in sealed containers stored at 4°C or 5°C without loss of viability.

Under natural conditions, germination will generally take two years, unless the seeds are sown in the early fall; warm temperatures for one or two months should result in faster bacterial and fungal action on the impermeable pericarp.

Propagation by cuttings: According to Coggeshall (1957), softwood cuttings taken from a 26 year-old parent plant and treated with Hormodin #3^o resulted in a rooting rate of 63% after six weeks; the root system was highly developed (three to eight roots per cutting).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Schumacher, United States

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

Propagation technique: The seeds were sown outside on November 10, 1982, and some germinated the following spring. The seedlings were cultivated in a frame until July 10, 1984. They were then potted in small pots and returned to the frame until they were shipped in May 1985. The winter survival rate was 74%.

Inclusion in test network: Young seedlings 15 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

A few seedlings died, at La Pocatière only. In general, damage was limited to mild frost damage on the tip of the stems.

Region 1

At Sainte-Clotilde, all the seedlings suffered frost damage on the shoot tip following the second winter only. At the L'Assomption site on sand, this type of damage was evident on 40% to 80% of the seedlings following the second, third and fourth winters, and at Sainte-Anne-de-Bellevue, it was evident annually on 33% to 100% of the seedlings.

At the L'Assomption site on clay, one or two seedlings suffered more severe damage during the last three winters.

Damage caused by rodents was observed mainly following the first winter.

Region 2

At Sainte-Foy, frost damage on the shoot tip occurred four winters out of five on 25% to 100% of the seedlings, while at Deschambault, 67% to 100% of the seedlings were affected by the same type of damage the third and fourth winters only.

At La Pocatière, the most severe damage occurred during the second winter: 30% of the seedlings suffered frost damage on the old wood, 20% suffered frost damage on the entire stem and 15% died. During the five years of testing, 18% to 100% of the seedlings were affected by frost damage on the shoot tip.

Region 3

All the seedlings at Normandin and at Kapuskasing were affected by mild frost damage the second, third and fourth winters. At Kapuskasing, mechanical breakage also occurred on 25% of the seedlings during the last winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.18 m R2 = 2.45 m R3 = 2.12 m

Categories

The average height of the trees after five years varied from one site to another:

3.51 m and + : Sainte-Clotilde
 3.01 - 3.50 m : Sainte-Anne-de-Bellevue
 2.51 - 3.00 m : L'Assomption on sand and Deschambault
 2.01 - 2.50 m : La Pocatière, Sainte-Foy and Kapuskasing
 1.76 - 2.00 m : L'Assomption on clay and Normandin

At the end of the test, the trees at Sainte-Clotilde and at Sainte-Anne-de-Bellevue were clearly taller than those at the other sites.

Effect of pruning

Annual pruning was approximately 30% to 40% at most of the sites, with the exception of the Deschambault, La Pocatière and Kapuskasing sites, where almost no pruning was done.

***Acer tataricum* L.**

Growth in width

After five years, the average width of the trees for each region was:

R1* = 1.70 m R2 = 1.58 m R3 = 1.35 m

* This average excludes the two sites at L'Assomption, where the seedlings were pruned at the beginning of the testing period to obtain a single stem.

Categories

The average width of the trees after five years varied from one site to another:

1.51 - 2.00 m: Sainte-Foy, Sainte-Clotilde, Sainte-Anne-de-Bellevue and La Pocatière
 1.01 - 1.50 m: Kapuskasing, Normandin and Deschambault

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height and width.

Production

After five years, the seedlings were definitely higher at the Sainte-Clotilde and Sainte-Anne-de-Bellevue sites. However, they established themselves more quickly during the initial years at Sainte-Foy and at Normandin.

After three years of cultivation, 82% of the seedlings at Sainte-Clotilde had attained a height ranging from 1.50 to 2.50 m, which made it the site with the fastest production.

The production of this species is mainly recommended in region 1. Just like *Acer Ginnala*, *Acer tataricum* grows very slowly in sites in regions 2 and 3.

Use

Acer tataricum proved to be very resistant. The results obtained show that a 2b zoning, previously established by Sherk and Buckley, is slightly underestimated and that this plant tolerates well the climates associated with regions zoned 2a. This species can be used anywhere in Quebec and northeastern Ontario without risk of serious damage.

BIBLIOGRAPHICAL REFERENCES

2, 3, 19, 27, 29, 43, 56, 57, 60, 86, 103

WRITTEN BY

Claude Richer, Agr.
 Jacques-André Rioux, Agr.
 Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Acer tataricum* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	75	13		5				5		2	25
L'Assomption-sand	67	33									33
Ste-Anne-de-Bellevue	17	77						2		4	83
Sainte-Clotilde	80	20									20
REGION 2											
Deschambault	54	42								4	46
Sainte-Foy	51	49									49
La Pocatière	31	56	4				3		6		69
REGION 3											
Normandin	40	60									60
Kapuskasing	48	47								5	52

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 and 7 occurred in this species.

Table 2: Breakdown of *Acer tataricum* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	100	52	0	0	0	95	19	0	8	0	85	15	0	0	0	85	19	0	0	0					
51-100	0	48	58	8	0	5	81	17	25	8	15	55	0	0	0	15	81	8	0	0					
101-150	0	0	42	50	0	0	0	75	17	0	0	30	18	0	0	0	0	59	8	0					
151-200	0	0	0	42	0	0	0	8	50	50	0	0	45	0	0	0	0	33	17	9					
201-250	0	0	0	0	17	0	0	0	0	42	0	0	37	10	0	0	0	0	42	9					
251-300	0	0	0	0	83	-	-	-	-	-	0	0	0	50	9	0	0	0	33	18					
301-400	-	-	-	-	-	-	-	-	-	-	0	0	0	40	73	0	0	0	0	64					
401 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	18	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	76	5	0	0	0	100	24	0	0	0	100	44	0	0	0	95	0	0	0	0	100	33	0	0	0
51-100	24	90	0	0	0	0	71	8	0	0	0	56	45	0	0	5	90	0	0	0	0	52	33	0	0
101-150	0	5	50	0	0	0	5	92	0	0	0	0	45	0	0	0	10	100	0	0	0	15	25	25	0
151-200	0	0	50	75	17	0	0	0	50	0	0	0	10	73	18	0	0	0	100	50	0	0	25	67	16
201-250	0	0	0	25	50	0	0	0	50	42	0	0	0	27	46	0	0	0	0	50	0	0	17	8	67
251-300	0	0	0	0	33	0	0	0	0	58	0	0	0	0	36	-	-	-	-	-	0	0	0	0	17
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Acer tataricum* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-40	100	100	42	0	0	100	95	25	8	0	100	95	9	0	0	NA	NA	NA	0	0					
41-80	0	0	58	42	0	0	5	58	50	33	0	5	64	0	0	NA	NA	NA	16	0					
81-120	0	0	0	58	8	0	0	17	42	50	0	0	27	82	0	NA	NA	NA	34	9					
121-160	0	0	0	0	42	0	0	0	0	17	0	0	0	18	82	NA	NA	NA	42	27					
161-200	0	0	0	0	50	-	-	-	-	-	0	0	0	0	18	NA	NA	NA	8	64					
Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	100	72	0	0	0	100	95	17	0	0	100	84	18	0	0	100	57	0	0	0	100	56	25	0	0
41-80	0	28	17	0	0	0	5	67	33	0	0	16	63	0	0	0	43	25	17	0	0	44	58	25	0
81-120	0	0	50	34	0	0	0	16	58	50	0	0	19	27	9	0	0	75	83	42	0	0	8	67	17
121-160	0	0	17	41	18	0	0	0	9	42	0	0	0	46	36	0	0	0	0	58	0	0	9	8	58
161-200	0	0	16	25	82	0	0	0	0	8	0	0	0	27	55	-	-	-	-	-	0	0	0	0	25

Actinidia Kolomikta (Rupr. and Maxim) Maxim.

See colour plate

Family	:	Actinidiaceae (sometimes classed among Ternstroemiaceae)
English name	:	Actinidia
French name	:	Actinidia
Category	:	Deciduous plant
Subdivision	:	Climbing or creeping plant

BOTANICAL DESCRIPTION

This climbing plant can reach a height of 6 m.

The stems are dark brown, covered with visible lenticels and swollen nodes.

The buds may be superimposed, with the largest overlapping the leaf scar.

The leaves are alternate, simple, broadly ovate, reaching a length of 6 to 15 cm and a width of 3 to 12 cm. They are cordate, acuminate, sharp, uniformly toothed and slightly pubescent on the veins of the underside. The petiole is glabrous and 2.5 to 4 cm long. This species is recognizable from the white or pinkish colour of half or all of the leaf on the male plants.

The greenish-white flowers are inconspicuous, fragrant and 1 to 1.5 cm in diameter. They are positioned in the leaf axil in groups of one to three flowers and appear in May or June. The stamens are yellow.

The fleshy fruit, oblong-ovoid in shape, is sweet and edible. It reaches a length of 2.5 cm and ripens in the fall.

ORIGIN AND DISTRIBUTION

This species originates in central and western China and ranges from northeastern Asia as far as Japan. It was introduced around 1855.

USE

Ornamental: This species is less voluble than *Actinidia arguta* and requires a support to grow upwards. The dense foliage of the male plants is a mixture of white and pink, but its remarkable coloration at the beginning of leafing fades during summer.

REQUIREMENTS

The colours are more vivid in limestone soils and this species prefers southern or western exposures.

This species is less hardy than *Actinidia arguta* but it adapts well in well-drained soil. Excessive fertilization and shady sites can alter the colour of the leaves. Mature plants display more vivid colours. This species demands a lot of care, particularly during the first year, until it is established.

PATHOLOGY

To our knowledge, this plant is not particularly affected by diseases or insects.

PROPAGATION

Propagation by cuttings: Certain authors report a success rate of approximately 40% with softwood cuttings treated with a solution of 8,000 ppm IBA.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The information concerning the propagation of this species has been lost.

Inclusion in test network: Young male plants 15 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

The regeneration of growth after transplanting was very difficult at all the sites, except at L'Assomption.

Region 1

No damage was observed at the L'Assomption site on sand. However, at the L'Assomption site on clay, damage was observed on almost all the plants on two occasions. The third winter, 8% of the plants died, 25% and 50% of the plants froze down to the level of snow cover and to ground level respectively; the fourth winter, 10% of the plants died and 90% of the plants were affected on the previous year's wood.

At Sainte-Clotilde and at Sainte-Anne-de-Bellevue, mortality was very high. At Sainte-Clotilde, winter damage affected 64% of the plants to varying degrees the first winter and virtually all of the plants died following the second and third winters. At Sainte-Anne-de-Bellevue, in addition to the gradual mortality which was observed four winters out of five, 70% of the plants froze down to the snow level following the third winter and 10% to 75% of the plants suffered frost damage on the shoot tip every year.

Region 2

At Sainte-Foy, damage on the shoot tip was observed on all the plants on two occasions only.

At Deschambault, damage was observed following the last two winters and all the plants suffered frost damage, most on the shoot tip and the others on the previous year's shoot. Only one plant died following the third winter.

At La Pocatière, the plants behaved essentially the same way as at Deschambault: 40% to 50% of the plants suffered frost damage on the shoot tip following the second, third and fourth winters and 25% suffered frost damage on the previous year's shoot.

Region 3

At Normandin, all the plants died on planting.

At Kapuskasing, 70% of the plants died on planting and the others died following the first winter.

Growth in height

The average height of the plants was quite different from one site to another and the high mortality observed from the first few winters does not make it possible to really establish regional averages, since the number of living plants at the sites was too variable.

Categories

The average height of the plants after five years varied from one site to another:

2.01 m and +:	Sainte-Foy
1.76 - 2.00 m:	L'Assomption on sand
1.51 - 1.75 m:	-
1.26 - 1.50 m:	Sainte-Anne-de-Bellevue, L'Assomption on clay and Deschambault
1.01 - 1.25 m:	Sainte-Clotilde and La Pocatière

Effect of pruning

In general, spring pruning was carried out only to eliminate damage suffered by the plants the previous winter.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at the test sites where a sufficient number of living plants made it possible to determine the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

The percentage of loss on planting varied from 25% to 100% depending on the sites, which leads us to conclude that the cutting's root system must be very well developed when it is transplanted in the field if we wish to ensure a good regeneration of growth.

These losses on transplanting do not enable us to establish a reliable picture of the behaviour of the species across all zones of Quebec. However, the survival of the young plants at the L'Assomption on sand, Deschambault, Sainte-Foy and La Pocatière sites appears to be related to the presence of good snow coverage during the winter.

***Actinidia Kolomikta* (Rupr. and Maxim) Maxim.**

Use

It is difficult to accurately determine the zone rating for this species, although the U.S. zoning is between 4 and 8. The test results lead us to believe that the young plants may be more sensitive to the cold than the adult plants. For instance, some male plants in the collection at the Roger-Van den Hende Garden in Sainte-Foy and at the Montreal Botanical Garden generally do not exhibit any winter damage; in zone 4 or 5 the adult plants seem to be resistant to the climatic conditions.

BIBLIOGRAPHICAL REFERENCES

3, 27, 46, 47, 57, 60

WRITTEN BY

Claude Richer, Agr.
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Laurier Guillemette, Agr.

Table 1: Frequency of winter damage observed on *Actinidia Kolomikta* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	6	7	8	5 and 9	10	11	
REGION 1											
L'Assomption-clay	60			18	5	12	5				40
L'Assomption-sand	100										0
Ste-Anne-de-Bellevue	25	45	2		14		14				75
Sainte-Clotilde ^b	64	7	2	2			19			6	36
REGION 2											
Deschambault	53	35		10			2				47
Sainte-Foy	62	38									38
La Pocatière	62	33		5							38
REGION 3											
Normandin ^c	-										-
Kapuskasing ^d	-										-

- ^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 splitting
10 = mechanical breakage related to weather conditions
11 = damage by rodents

No damage of types 5, 9 and 10 occurred for this species.

^b For the last two years, the evaluation was conducted on three plants only.

^c No plants survived on planting at Normandin.

^d No plants survived beyond the first winter at Kapuskasing.

Table 2: Breakdown of *Actinidia Kolomikta* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-40	100	67	0	0	0	78	66	8	10	0	100	100	0	0	0	100	0	0	0	0					
41-80	0	33	33	8	0	22	34	50	50	0	0	0	67	67	0	0	75	0	25	0					
81-120	0	0	34	17	0	0	0	42	40	10	0	0	33	33	100	0	17	60	50	25					
121-160	0	0	33	50	8	0	0	0	0	60	-	-	-	-	-	0	8	40	25	50					
161 and +	0	0	0	25	92	0	0	0	0	30	-	-	-	-	-	0	0	0	0	25					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	93	13	0	0	0	100	82	11	10	10	100	25	18	0	0	-	-	-	-	-	-	-	-	-	-
41-80	7	40	0	0	0	0	18	78	0	0	0	75	82	27	9	-	-	-	-	-	-	-	-	-	-
81-120	0	40	0	0	0	0	0	11	0	10	0	0	0	63	73	-	-	-	-	-	-	-	-	-	-
121-160	0	7	45	27	0	0	0	0	20	70	0	0	0	10	18	-	-	-	-	-	-	-	-	-	-
161 and +	0	0	55	73	100	0	0	0	70	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Aesculus hippocastanum L.

See colour plate

Family	:	Hippocastanaceae
English name	:	Buckeye, common horsechestnut
French name	:	Marronnier d'Inde
Category	:	Deciduous plant
Subdivision	:	Large tree

may contain one or sometimes two seeds. They are not edible and are of no commercial interest.

ORIGIN AND DISTRIBUTION

The genus name *Aesculus* designates any tree which produces fruit intended for cattle. It comes from the Greek *aesca*, which means nourishing. *Aesculus hippocastanum* is the contraction of two Greek words, *hippos* and *kastanon*, which are translated as horse and chestnut tree. Its name comes from the resemblance of its fruit to that of the chestnut tree. This species originates in the Balkan Peninsula, more specifically Greece and Albania. It has been used since 1576 in the United States and has been very popular.

BOTANICAL DESCRIPTION

This oval tree with a regular growth habit and a rounded crown can grow as high as 20 to 25 m and as wide as 18 to 22 m in the United States and in exceptional cases can reach a width of 30 m. It has grown to a height of up to 10 m in western Canada but has rarely attained this height in Ottawa. It is generally composed of wide branches which are easily broken by the wind, creating numerous routes for infection.

The young branches are reddish-yellow and sometimes grey-brown. They are glabrous or finely pubescent. The dark grey or brown bark is cracked, fissured and covered with small scale-like plates.

The buds, covered with scales and coated with a viscous, sticky substance, are reddish-brown. They are overlapping, wide and 2 to 3 cm long. Budbreak occurs very early in the spring.

The wide opposite leaves are generally composed of seven leaflets. They are 10 to 20 cm long. They are acuminate, obtuse, double-serrated and tomentose in texture. The spring colour of the foliage is greenish-yellow, changing to dark green during the summer season and becoming brownish in the fall. The foliage is dense.

The inflorescences, thyrses, are erect and are more than 15 cm high. Each flower is composed of four or five petals, which range in colour from yellow to reddish at the base of the corolla.

The young fruits are yellowish, turning light brown when they ripen in the fall. They are globular, spiny and dehiscent. The capsule is 5 to 6 cm in diameter and

USE

Ornamental: This tree has been widely used in cities in the United States, particularly for its spectacular flowering. It has been valuable because of its ability to adapt to the urban environment, but it has been supplanted by its cultivars because of the problems caused when its fruit falls from the tree. It is used in large open spaces, golf courses, campuses, parks and arboretums. This species must be protected from the wind, which can break its branches and cause serious frost damage in the winter. Drought causes brown spots or premature leaf fall.

REQUIREMENTS

This tree is transplanted by the root ball method in very moist, well-drained soil. It prefers sunny or semi-shady exposures and adapts to several conditions of soil pH.

PATHOLOGY

This species is sensitive to a fungus (*Guignardia aesculi*) which causes severe defoliation of the plant. Small circular patches, caused by *Septoria hippocastani*, develop occasionally on the foliage. Mildew (*Uncinula flexuosa*) produces a white mould under the surface of the leaves. The terminal stems can be affected by anthracnose (*Glomerella cingulata*).

PROPAGATION

Seedlings: The viability of the fresh fruits is limited to six months when they are stored in sealed plastic bags at 2°C. When they are stored at -2°C over a period of 13 months, their germination rate decreases from 85% to 60%, and after 15 months it is only 25%. The seeds

must be stratified for 120 days in a moist substrate at 5°C. In production, these seeds are placed in the ground in the fall, after instituting protection against squirrels.

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 fruit was harvested on October 5, 1984 from 30-year-old parent plants. On October 15, the seeds were sown in a planting bed, spaced 15 cm apart. The germination rate was 98% in the spring of 1985. The seedlings were grown in the planting bed and heeled in in the fall. They were shipped to the evaluation sites in the spring of 1986.

Inclusion in test network: Young seedlings 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

No damage was observed at the L'Assomption on sand and Sainte-Clotilde sites.

At the l'Assomption site on clay, only one seedling died during the second winter. Damage was greater during the fourth and fifth winters: in 1990, half of the seedlings suffered frost damage on the shoot tip or on the previous year's shoot, 25% exhibited frost damage on the old wood and one seedling was gnawed by field mice; in 1991, a few seedlings suffered frost damage down to the level of the snow cover or on the shoot tip.

Region 2

At Sainte-Foy, no damage occurred following the first and last winters. Between 35% and 65% of the seedlings were affected by frost damage on the stems during the other three winters; 43% and 17% of the seedlings suffered damage on a large part of the previous year's shoot in 1988 and 1989 respectively.

At Deschambault, the number of seedlings damaged by frost was less than 20% the second and last winters. In 1989, 50% of the seedlings exhibited frost damage on the shoot tip and the entire previous year's shoot froze on one seedling. The following winter, all the seedlings suffered this same type of frost damage.

At La Pocatière, two seedlings died during the first winter and one seedling suffered frost damage on the previous year's shoot. No other damage occurred during the test.

Region 3

At Normandin, no damage was observed the first three winters. The following winter, 67% of the seedlings suffered frost damage on the shoot tip and 25% on the entire previous year's shoot. The last winter, 42% of the seedlings were affected by frost damage on the shoot tip.

At Kapuskasing, frost damage was severe the first winter, affecting 48% of the seedlings on the shoot tip and 10% of the seedlings down to ground level. The seedlings suffered mild frost damage the fourth winter and no damage the other winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.33 m R2 = 1.33 m R3 = 0.58 m

Categories

The average height of the trees after five years varied from one site to another:

1.76 m and + : Sainte-Foy
 1.51 - 1.75 m: Sainte-Clotilde
 1.26 - 1.50 m: L'Assomption on sand
 1.01 - 1.25 m: La Pocatière and Deschambault
 1.00 m and - : L'Assomption on clay, Normandin and Kapuskasing

Aesculus hippocastanum L.

The maximum height attained by the trees at Sainte-Foy was 2.90 m; since a number of seedlings were smaller, the average decreased considerably. Generally speaking, these plants grown from seeds exhibited significant variations in growth and one seedling out of three or out of four was significantly smaller.

Effect of pruning

Pruning was related to damage only. Pruning was necessary to promote leader growth.

Growth of trunk diameter

After five years, the average diameter of the tree trunks for each region was:

R1 = 47.3 mm R2 = 43.4 mm R3 = 32.8 mm

Categories

The average diameter of the trees after five years varied from one site to another:

51 mm and +: Deschambault
 41 - 50 mm: L'Assomption on sand, L'Assomption on clay and Sainte-Clotilde
 31 - 40 mm: La Pocatière, Sainte-Foy, Kapuskasing and Normandin

There was little difference between the trees regardless of the site.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

The production of this species cannot be recommended throughout Quebec, since it does not easily tolerate the spring frosts which occur in our climatic conditions. The warmer regions of zone 5b are more competitive.

Use

The testing demonstrated that the 5b zoning established by Buckley and Sherk is suited to the potential of this species. However, the testing leaves some uncertainty concerning the potential of this plant since it appears to be frost-sensitive during the early years. Adult specimens are found in large numbers in the eastern region of Quebec City, along the St. Lawrence River, and this species will be tested again with plants derived from more adapted seedstock.

It is recommended that this species be protected against wind. In high snowfall regions, mechanical breakage related to precipitation has caused damage.

BIBLIOGRAPHICAL REFERENCES

4, 6, 21, 27, 35, 49, 51, 56, 57, 60, 65, 71, 72, 86, 90, 101

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Aesculus hippocastanum* from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	79	3	8	3		1	5		1	21	
L'Assomption-sand	100									0	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	54	17	27					2		46	
Sainte-Foy	59	29	12							41	
La Pocatière	97		1			2				3	
REGION 3											
Normandin	73	22	5							27	
Kapuskasing	68	30		2						32	

- ^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 splitting |
| 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, 7 and 9 occurred for this species.

Table 2: Breakdown of *Aesculus hippocastanum* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	100	30	0	0	0	100	85	8	0	17	100	67	0	0	0										
51-100	0	70	92	16	33	0	15	92	42	58	0	33	75	17	0										
101-150	0	0	8	59	25	0	0	0	58	17	0	0	25	75	17										
151-200	0	0	0	25	25	0	0	0	0	8	0	0	0	8	75										
201 and +	0	0	0	0	17	-	-	-	-	-	0	0	0	0	8										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	14	0	0	0	100	90	0	0	0	100	100	75	0	0	100	85	67	17	17	100	100	84	50	50
51-100	0	76	33	17	17	0	10	83	42	67	0	0	25	83	25	0	15	33	42	83	0	0	16	50	50
101-150	0	10	34	42	17	0	0	17	58	33	0	0	0	17	58	0	0	0	33	0	-	-	-	-	-
151-200	0	0	33	33	25	-	-	-	-	-	0	0	0	0	17	0	0	0	8	0	-	-	-	-	-
201 and +	0	0	0	8	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Aesculus hippocastanum* plants by marketable trunk diameter category from 1986 to 1990

Trunk diameter (mm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-10	40	0	0	0	0	75	0	0	0	0	29	0	0	0	0
11-20	60	15	0	0	0	25	48	8	8	0	71	24	0	0	0
21-30	0	85	0	17	0	0	52	42	9	17	0	71	8	0	0
31-40	0	0	63	16	17	0	0	42	33	0	0	5	75	59	17
41-50	0	0	37	67	50	0	0	8	42	50	0	0	17	33	58
51-60	0	0	0	0	33	0	0	0	8	25	0	0	0	8	25
61-70	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-

Trunk diameter (mm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-10	57	0	0	0	0	5	0	0	0	0	76	44	0	0	0	48	10	0	0	0	14	19	NA	0	0
11-20	43	5	0	0	8	95	19	0	0	0	24	56	50	8	0	52	71	25	8	0	86	81	NA	17	0
21-30	0	90	75	42	17	0	81	33	8	0	0	0	50	67	8	0	19	58	58	42	0	0	NA	58	25
31-40	0	5	25	58	25	0	0	58	50	0	0	0	17	50	0	0	17	25	50	0	0	0	NA	25	67
41-50	0	0	0	0	33	0	0	9	42	50	0	0	0	8	34	0	0	0	9	8	0	0	NA	0	8
51-60	0	0	0	0	17	0	0	0	0	42	0	0	0	0	8	-	-	-	-	-	-	-	NA	-	-
61-70	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-

Alnus crispa (Ait.) Pursh

See colour plate

Family	:	Betulaceae
English name	:	American green alder, mountain alder
French name	:	Aulne crispé
Synonym	:	<i>Alnus mitchelliana</i> M.A.Curt, <i>Alnus viridis</i> (Chaix) DC, <i>Alnus viridis</i> ssp. <i>crispa</i> (Ait.) Turrill
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This indigenous shrub with a spreading growth habit can reach a height of 3 m, but it becomes prostrate in very exposed sites.

The bark is smooth in young specimens, and marked by conspicuous horizontal lenticels.

The young stems are glabrous, sometimes pubescent, frail and reddish. The buds are composed of three or four triangular, reddish or greenish scales.

The leaves are glutinous, almost glabrous and aromatic when young. They are oval and slightly elliptical, ranging in length from 3 to 8 cm. According to certain authors, *A. viridis* and the subspecies *crispa* are distinguished by the latter's rounded to slightly cordate base. The margin is double-toothed and the lower surface of the leaves is green.

The upright and pedunculated female catkins resemble small reddish-brown pine cones and remain on the tree throughout the year. The drooping male catkins form in late summer and are 10 to 15 mm long. They spend the winter in this form and open up during the following spring.

The fruits are small winged achenes, protected by woody scales attached to a rigid central axis. They reach maturity in the fall and the scales of the cone partially open to facilitate their dispersal.

The root system is superficial. The roots have bacteroid-containing nodules, similar to those on leguminous plants, which can fix atmospheric nitrogen.

ORIGIN AND DISTRIBUTION

This species, indigenous to eastern Canada, was identified in 1782. There are still a number of controversies concerning its taxonomic status: some botanists consider it a subspecies, others a species. The area of distribution of this northern shrub extends across the entire width of the continent and is essentially the same as that of the Sitka alder in northwestern Canada. It is found in New Brunswick, from Labrador to western North Carolina, in Ontario, in northern Michigan, in Minnesota and in Alberta. It is uncommon in Quebec.

USE

This species is used in clumps to stabilize slopes along rivers and streams. Furthermore, its ability to fix nitrogen gives it an advantage in poor, dry soils and in disturbed sites.

REQUIREMENTS

This species is found in nature in very moist, swampy or shady sites, where most other species cannot survive. It is also found in mountainous and rocky areas.

The soil pH can range from slightly acidic to slightly alkaline.

It is easily transplanted and becomes established quickly.

PATHOLOGY

Powdery mildew occasionally attacks the female catkins, but rarely seriously. Cankers can become a problem, as well as attacks from tent caterpillars. Occasionally, the larvae of the alder leafminer [*Fenusa dohrnii* (Tisch.)] can attack the leaves, feeding between their epidermal layers.

PROPAGATION

Seedlings: The fruit is harvested from the shrub as soon as the scales of the cone separate. It is dried at room temperature and most of the seeds fall during this operation. The seeds must be cleaned by sieving or ventilation. Sown in the fall, under natural conditions, they germinate the following spring. It is also possible to carry out a spring seeding by stratifying the seeds for

a period of 60 to 90 days at 4°C in a substrate of moist sand.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: James Bay (L.G. 2), Quebec

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

Propagation technique: The seeds were sown in a greenhouse on June 1, 1983, after soaking in water for 24 hours. The seedlings were potted in individual cells and placed outside until the fall. They were planted in the nursery on June 6, 1984. In May 1985, they were dug up, puddled, packed and shipped for evaluation.

Inclusion in test network: Young seedlings 14 to 18 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

This species occasionally suffered mild frost damage on the tip of the stems in region 2 and at Sainte-Anne-de-Bellevue. No mortality occurred.

Region 1

No frost damage occurred on the seedlings for the duration of testing, except at Sainte-Anne-de-Bellevue.

Region 2

At Deschambault, no frost damage affected the seedlings.

At Sainte-Foy and at La Pocatière, damage occurred on one occasion, on 50% to 60% of the seedlings.

Region 3

No frost damage was observed at the two sites in this region.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.74 m R2 = 2.18 m R3 = 1.39 m

The shrubs in region 2 were, on average, higher than those in the other regions. At Sainte-Clotilde, the height attained the last year was lower than that obtained the previous year. Only the shrubs at Sainte-Foy and at Kapuskasing displayed continuous growth throughout the duration of the testing.

Categories

The average height of the shrubs after five years varied from one site to another:

2.26 - 2.50 m: Sainte-Foy
 2.01 - 2.25 m: Deschambault, Sainte-Anne-de-Bellevue and La Pocatière
 1.51 - 2.00 m: L'Assomption on sand, Sainte-Clotilde and Normandin
 1.01 - 1.50 m: L'Assomption on clay and Kapuskasing

Effect of pruning

Pruning was more severe at the Deschambault, Sainte-Anne-de-Bellevue and Normandin sites (approximately 30%).

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.32 m R2 = 1.52 m R3 = 0.96 m

The width of the seedlings in region 2 was greater than that of the seedlings in the other regions.

Categories

The average width of the shrubs after five years varied from one site to another:

<i>Alnus crispa</i> (Ait.) Pursh ...

- 1.51 - 2.00 m: Sainte-Foy and L'Assomption on sand
 1.26 - 1.50 m: La Pocatière, Sainte-Anne-de-Bellevue
 and Sainte-Clotilde
 1.01 - 1.25 m: Deschambault and L'Assomption on
 clay
 0.81 - 1.00 m: Kapuskasing and Normandin

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

It took two years for 95% of the shrubs at Sainte-Foy to reach a height ranging from 1.5 to 2.0 m. After the third year, all the seedlings at the L'Assomption on sand, Sainte-Clotilde, Sainte-Anne-de-Bellevue and Deschambault sites had attained this height. At the La Pocatière and Normandin sites, 42% to 67% of the seedlings had attained a comparable height. This species can be produced for very specific needs.

Even though it is used particularly in wet, swampy soils, its growth in heavy soils was poorer.

Use

Sherk and Buckley mention this species but do not assign it any zone rating. Results show that it is hardy even in zone 1b since no frost damage was evident at Kapuskasing during the five years of testing.

BIBLIOGRAPHICAL REFERENCES

2, 3, 30, 57, 60, 65, 71, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Alnus crispa* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	100									0
L'Assomption-sand	100									0
Ste-Anne-de-Bellevue	20	80								80
Sainte-Clotilde	100									0
REGION 2										
Deschambault	100									0
Sainte-Foy	89	11								11
La Pocatière	85	15								15
REGION 3										
Normandin	100									0
Kapuskasing	100									0

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 to 11 occurred in this species

Table 2: Breakdown of *Alnus crispa* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	14	0	0	0	0	29	0	0	0	0	10	5	0	0	0	10	0	0	0	0					
51-100	86	0	0	0	0	71	76	0	17	0	90	10	0	0	0	90	0	0	0	0					
101-150	0	95	0	17	8	0	24	100	83	67	0	52	17	8	42	0	57	0	0	0					
151-200	0	5	75	83	92	0	0	0	0	33	0	33	83	67	50	0	43	67	58	50					
201-250	0	0	25	0	0	-	-	-	-	-	0	0	0	25	8	0	0	33	42	50					
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	19	0	0	0	0	100	76	0	0	0
51-100	29	0	0	0	0	95	0	0	0	0	0	90	0	0	0	81	81	0	0	0	0	24	92	25	25
101-150	71	5	0	0	8	5	86	0	0	0	0	10	58	0	0	0	19	33	25	50	0	0	8	75	75
151-200	0	86	17	0	8	0	14	100	25	25	0	0	42	58	67	0	0	67	75	50	-	-	-	-	-
201-250	0	9	75	92	34	0	0	0	67	75	0	0	0	42	33	-	-	-	-	-	-	-	-	-	-
251-300	0	0	8	8	50	0	0	0	8	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Alnus glutinosa L.

See colour plate

Family	:	Betulaceae
English name	:	European alder, black alder, common alder
French name	:	Aulne, verne
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

In the United States, this tree can reach a height of 18 m when cultivated as a single stem; as a shrub, it can grow to 7 m. The growth habit is irregular, varying from the pyramidal form to the ovoid form. It grows quickly, as much as 60 to 90 cm annually, but growth tends to be slower in years of heavy flowering or fruit production.

The bark is smooth on the young trees, shiny green-grey or greenish-brown, and marked by conspicuous horizontal lenticels. It becomes plain brown with age.

The foliage is dense and dark green until leaf fall. The leaves, from 7 to 10 cm wide, are alternate, smooth, round, glabrous and generally serrated at the top. They remain on the tree until late fall. The leaf margins are coarsely double-toothed. The buds are reddish or purplish, and the lateral buds are pedunculated.

The spring flowers are reddish-brown. The catkins form in late summer and the following spring, they develop before or at the same time as the leaves. The male catkins are yellow, 5 to 7 cm long, and fall after flowering. The female catkins resemble small brown pedunculated pine cones and remain on the tree throughout the year.

The fruits are small winged achenes, protected by woody scales attached to a rigid central axis. They reach maturity in the fall and the scales of the cone partially open to facilitate their dispersal.

The root system is superficial. The roots have bacteroid-containing nodules, similar to those on leguminous plants, which can fix atmospheric nitrogen.

ORIGIN AND DISTRIBUTION

Etymology: The genus name reportedly comes from a Celtic word meaning "neighbour of the rivers."

This species originates in Eurasia, but its natural area of distribution covers Europe, northern and western Asia, as well as north Africa.

USE

Ornamental: This species can be used in clumps to stabilize the slopes along rivers and streams. Furthermore, its ability to fix nitrogen gives it an advantage in poor, dry soils and in disturbed sites.

Naturalization: In Ontario, it is used in evergreen plantings to improve the soil, and in Europe, it is planted instead of birches and poplars along the banks of rivers and streams.

Wood use: The wood is light, soft and not very strong. Its commercial value is purely local.

REQUIREMENTS

This species prefers moist soils, near sources of water, and sunny sites, but it adapts well to shady locations and to dry, poor, sandy or gravelly soils.

The soil pH can range from slightly acidic to slightly alkaline. It is easily transplanted and becomes established quickly.

PATHOLOGY

Powdery mildew occasionally attacks the female catkins, but rarely seriously. Cankers can become a problem, as well as attacks from tent caterpillars. Occasionally, the larvae of the alder leafminer [*Femusa dohrnii* (Tisch.)] can attack the leaves, feeding between their epidermal layers.

PROPAGATION

Seedlings: The fruit is harvested from the tree as soon as the scales of the cone separate. It is dried at room temperature to extract the seeds. The seeds are cleaned by sieving or ventilation. They are sown in a planting bed or frame and germination takes place the following spring. Stratification can be performed by placing the seeds in a substrate of moist sand at 4°C for a period of 60 days.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Italy

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

Propagation technique: Seeds were sown in a greenhouse on June 1, 1983, after soaking in water for 24 hours. The seedlings were potted in individual cells and placed outside until the fall. On June 6, 1984, they were transplanted to the nursery. The winter survival rate was 100%. In May 1985, they were dug up, puddled, wrapped and shipped.

Inclusion in test network: Young seedlings 23 to 25 cm high were planted in nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and their growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

During the fourth year, this species was severely affected by a dieback similar to that caused by bacterial blight, as well as by a leaf miner, which largely accounts for the mortality in 1989.

Winter damage

The various types of damage observed on this species appeared mainly during the last two winters.

Region 1

Mortality, which occurred mainly after the winter of 1988-1989, was related to a disease which causes the same symptoms as bacterial blight, namely the partial dieback of the branches at the end of the season, followed by the total desiccation of the tree.

At Sainte-Anne-de-Bellevue, several other types of damage appeared during the fourth and fifth winters.

Region 2

Just as for region 1, mortality occurred during the fourth or fifth winters and is attributable to the same causes.

At Sainte-Foy and at Deschambault, frost damage was mild and infrequent.

At La Pocatière, more serious frost damage occurred following the winters of 1987, 1989 and 1990.

Region 3

This is the only region where no seedlings died.

At Normandin, damage was very slight on half of the seedlings, the second and third winters only.

At Kapuskasing, more severe frost damage occurred following the last two winters, limiting the survival of the stems to the level of the snow cover.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 4.09 m R2 = 3.91 m R3 = 1.91 m

The fifth year, the final height of the seedlings was less than the fourth year height at La Pocatière and at Normandin. At La Pocatière, tree-top breakage brought down the final average and, at Normandin, the seedlings were severely cut back the last year.

At Kapuskasing, Sainte-Clotilde and Sainte-Anne-de-Bellevue, no growth was noted in the last year.

Categories

The average height of the trees after five years varied from one site to another:

- 4.01 m and +: Sainte-Foy, Deschambault, L'Assomption on sand and Sainte-Clotilde
- 3.51 - 4.00 m: Sainte-Anne-de-Bellevue and L'Assomption on clay
- 2.51 - 3.00 m: La Pocatière
- 2.01 - 2.50 m: Normandin
- 1.51 - 2.00 m: Kapuskasing

Alnus glutinosa L. ...

Effect of pruning

At Normandin, pruning was very severe: approximately 30% the second and fourth growing seasons and 60% the third and fifth years.

There was almost no pruning at the two L'Assomption sites, at Sainte-Anne-de-Bellevue, at La Pocatière and at Kapuskasing. At the other sites, pruning was particularly extensive during the second and fifth seasons.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 1.91 m R2 = 2.50 m R3 = 1.65 m

At Deschambault and at Sainte-Anne-de-Bellevue, the width of the trees was not measured.

The Sainte-Foy site is the only one where growth increased over the five years. The La Pocatière site substantially brought down the average for its region.

Categories

The average width of the trees after five years varied from one site to another:

3.01 - 3.50 m: Sainte-Foy
 2.76 - 3.00 m: -
 2.51 - 2.75 m: -
 2.26 - 2.50 m: L'Assomption on sand
 1.76 - 2.00 m: Sainte-Clotilde
 1.51 - 1.75 m: Kapuskasing, L'Assomption on clay,
 La Pocatière and Normandin

RECOMMENDATIONS

Production

Despite the fact that it grew very quickly in the Montreal and Quebec City regions and that it fixes nitrogen, this alder cannot be recommended for production since it proved to be very susceptible to dieback, which quickly causes it to wither and die. However, this test, limited to plants from a single origin, does not make it possible

to generalize the results obtained to all other origins. Other studies should be undertaken to better define the potential of this species.

Use

This species did not suffer significant winter damage even in zone 2b. The zone rating of 4 mentioned by Buckley is underestimated and a new rating of 2b seems more appropriate.

In regions where the climate conditions are similar to those at Normandin, this plant can be used for renaturalization. However, it will grow more slowly than in warmer regions.

BIBLIOGRAPHICAL REFERENCES

2, 3, 12, 13, 30, 45, 47, 51, 57, 60, 65, 71, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Alnus glutinosa* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	92					8				8
L'Assomption-sand	95					5				5
Ste-Anne-de-Bellevue	44	32				4	15	5		56
Sainte-Clotilde	96					4				4
REGION 2										
Deschambault	67	8				21	4			33
Sainte-Foy	77	19				4				23
La Pocatière	45	30	4	1	4	3	13			55
REGION 3										
Normandin	80	20								20
Kapuskasing	49	10	4	33			2	2		51

- ^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 splitting |
| 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 and 11 occurred in this species.

Betula alleghaniensis Britton

See colour plate

Family	:	Betulaceae
English name	:	Yellow birch
French name	:	Bouleau jaune, merisier
Synonym	:	<i>Betula lutea</i> Michx.
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This large indigenous tree can attain a height of 30 m and a diameter of 60 cm in its native habitat. It has a slender growth habit. In the forest, the crown is ovoid and the top is conical or rounded. In trees standing alone, the crown tends to be oblong and broad.

In trees growing alone, the trunk normally subdivides into several large, spreading branches. When the tree grows in a close stand, the trunk becomes very long and accounts for more than half the tree's height.

The dark reddish bark is thin and shiny on the young stems, becoming yellowish or bronze as it matures. It sheds in thin, paper-like sheets but does not peel readily. On adult trees, it comes off in large, ragged-edged plates.

The branches are ascending. The young pubescent shoots are aromatic and give off a wintergreen fragrance produced by methyl salicylate.

The leaves are simple, alternate, deciduous and yellowish-green. They are 8 to 12 cm long and 4 to 7 cm wide. The stalk is oval, frequently cordiform, with a double-toothed margin. It is initially pubescent but subsequently becomes glabrous. The midvein is pubescent beneath, especially with the development of lateral veins. Nine to eleven pairs of veins can be seen. The petiole is short. The leaves turn golden yellow in the fall.

The ovoid to cone-shaped buds are light brown and overlapping. The male and female catkins are pubescent and thick. The male catkins appear in the fall and open up early in the spring. At this time, they attain a length

of 3 cm. The smaller female catkins appear during flowering, early in the spring.

The fruit, nutlets, are encased in an sturdy, oval, rigid and upright cone. The cones sometimes remain on the tree all winter, thus dispersing the seeds throughout the fall and into spring.

The root system is fairly deep and spreading.

ORIGIN AND DISTRIBUTION

This species originates in the eastern United States and can be found as far as southeastern Canada. It is one of the main components of Southern Deciduous Forests, the Acadian Forest Region and the Great Lakes-St. Lawrence Forest Region. It ranges as far the Boreal Forest Region in eastern Canada. It grows in stands with American beech, sugar maple, hemlock, white spruce and red spruce.

It was named around 1767. It has a lifespan of between 60 and 80 years.

USE

Ornamental: This species is very attractive for ornamental purposes because of the colour of its bark and its golden yellow fall foliage.

Wood use: Its wood is used in the United States to manufacture furniture, flooring and various objects because it is hard, strong and has a fine, closed grain. This wood stains well and can be finely polished.

Miscellaneous: This species is used as a raw material in distilleries. Because its wood does not float, it has been spared by the paper industry.

Forestry: This species is used for reforestation.

REQUIREMENTS

This species prefers rich, moist soils and is perfectly suited to marshy soils. Its growth is best during cool summer weather, slowing down during periods of drought or intense heat.

PATHOLOGY

This species appears to be more resistant to the insects that attack birches in general.

PROPAGATION

Seedlings: The cones are harvested when still green and placed directly in bags to avoid dispersal of the seeds. In order to prevent overheating, they must be dried for several weeks. The seeds are then separated from the cones by shaking and sieving. They are very small and light.

The seeds are generally sown in the spring, after four to eight weeks of stratification. They are covered if the substrate is dry and must be uncovered if the substrate is moist. Epigeous germination usually occurs four to six weeks after sowing. The young seedlings require shade for the first two or three months of their growth.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Whitney, Ontario

Propagation site: Agriculture and Agri-Food Canada Research Farm, L'Assomption, Quebec

Propagation technique: The seeds harvested in 1974 were sown on November 2, 1983 in a frame with 63% shade. On May 31, 1984, the germination rate was 18%. Thinning was carried out on July 4, 1985 and the young seedlings were left in the frame until October 22. They were dug up and heeled in until April 3, 1986; at that time they were 45 cm high. They were cut back to between 25 and 30 cm, put in plastic bags and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 25 to 30 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTATS (1986-1991)

Winter damage

Region 1

This plant suffered no winter damage at the sites in this region. However, all the seedlings at L'Assomption on clay were damaged by rodents during the second winter.

Region 2

At Sainte-Foy, no seedling mortality was recorded. Frost damage on the stem tips was observed on 90%, 37% and 33% of the seedlings after the first three winters. No damage occurred the last two winters.

At Deschambault, two trees died during the first and third winters. Damage due to mechanical breakage, caused by the weight of the snow, was reported on 8% and 36% of the seedlings after the third and fourth winters. No other damage on the seedlings was observed.

À La Pocatière, mortality was higher. All the seedlings in the second replication gradually died over the course of the first three winters. In addition, one seedling in replication 1 died the first winter and another in replication 3 in the third winter. Most of the frost damage occurred during the first winter, on 70% of the seedlings. Thereafter, the only damage observed was damage caused by rodents.

Region 3

At Normandin, mortality extended over several winters. Frost damage on the stem tips and on the previous year's shoot was apparent particularly during the second winter, affecting 25% of the seedlings.

At Kapuskasing, nearly half the seedlings died during the second and fourth winters, affecting nearly all the seedlings in replication 1 and a large proportion of the seedlings in replication 3. Frost damage on the stem tips occurred during the same winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.24 m R2 = 2.63 m R3 = 1.63 m

There was considerable heterogeneity at the sites in a given region.

Categories

The average height of the trees after five years varied from one station to another:

***Betula alleghaniensis* Britton ...**

3.51 - 4.00 m:	Sainte-Clotilde, Sainte-Foy
3.01 - 3.50 m:	L'Assomption on sand
2.51 - 3.00 m:	Deschambault
2.01 - 2.50 m:	Normandin and L'Assomption on clay
1.51 - 2.00 m:	-
1.50 m and - :	La Pocatière and Kapuskasing

Growth was lower at all the sites on clay soil.

In general, annual growth at a station was relatively stable over the years. On average, it took a year for the seedlings to become established. At Kapuskasing, annual growth was limited to approximately 10 cm a year.

Effect of pruning

This species required very little pruning.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 47 mm R2 = 37 mm R3 = 27 mm

The differences were very significant from one region to another.

Categories

The average diameter of the trees after five years varied from one station to another:

51 mm and +:	Sainte-Clotilde and L'Assomption on clay
41 - 50 mm :	Sainte-Foy and Deschambault
31 - 40 mm :	L'Assomption on clay
21 - 30 mm :	Normandin and La Pocatière
11 - 20 mm :	Kapuskasing

The trees had a smaller diameter at the sites with clay soils as well as in the colder climatic zones.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and trunk diameter obtained after each year.

Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined diameter or height.

Production

At the Sainte-Clotilde, L'Assomption on clay and Sainte-Foy sites, at least 67% of the trees attained a height of 2 or 3 m after three years of production. At the L'Assomption on clay and Deschambault sites, a fourth year was necessary in order to obtain a comparable production.

Results were similar for growth in trunk diameter. However, variability between the seedlings was more obvious.

The very weak growth observed at La Pocatière was due mainly to the pedological conditions of the plots at this site, which were not well suited to this species. The growth potential of this species might therefore be greater under better edaphic conditions.

Based on the results of our testing, the Montreal region offers conditions conducive to rapid growth, as do the pedological and climatic conditions at Sainte-Foy.

Use

This species survived at all the sites but the mortality rate was relatively high in zone 2a, while the other types of frost damage were very common, particularly at Kapuskasing. This mortality, which occurred gradually over the years on otherwise healthy seedlings suggests that natural selection is operating in this region to the benefit of the best adapted individuals.

The test results confirm the 3b zone rating previously assigned by Buckley. However, it is obvious that certain individuals of this species are sufficiently hardy to grow normally in zone 2b. The provenance of the seeds is therefore of great importance.

BIBLIOGRAPHICAL REFERENCES

4, 13, 16, 20, 27, 35, 50, 51, 57, 65, 83, 95

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Betula alleghaniensis* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	80								20		20
L'Assomption-sand	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	86				3			11			14
Sainte-Foy	68	32									32
La Pocatière	68	7	3			13	6		3		32
REGION 3											
Normandin	90	2	3			5					10
Kapuskasing	84	6				10					16

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 6 and 14 occurred for this species.

Table 2: Breakdown of *Betula alleghaniensis* seedlings by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-100	100	5	0	0	0	100	15	8	0	0	100	0	0	0	0										
101-200	0	95	33	0	0	0	85	83	33	17	0	95	8	0	0										
201-300	0	0	67	92	17	0	0	9	67	75	0	5	92	25	8										
301-400	0	0	0	8	83	0	0	0	0	8	0	0	0	50	33										
401-500	-	-	-	-	-	-	-	-	-	-	0	0	0	25	59										
501-600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	95	5	0	0	0	100	11	9	0	0	100	100	87	25	13	100	85	20	0	0	100	100	100	100	85
101-200	5	89	33	17	0	0	89	81	36	9	0	0	13	75	87	0	15	80	60	22	0	0	0	0	15
201-300	0	6	58	58	0	0	0	10	55	56	-	-	-	-	-	0	0	0	40	44	-	-	-	-	-
301-400	0	0	9	25	83	0	0	0	9	35	-	-	-	-	-	0	0	0	0	34	-	-	-	-	-
401-500	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
501-600	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Betula alleghaniensis* seedlings by marketable trunk diameter category from 1986 to 1990

Trunk diameter (mm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-10	95	0	0	0	0	95	5	0	0	0	100	0	0	0	0
11-20	5	67	0	0	0	5	95	58	8	0	0	62	0	0	0
21-30	0	33	50	0	0	0	0	42	84	17	0	38	42	17	8
31-40	0	0	50	50	0	0	0	0	8	75	0	0	42	25	17
41-50	0	0	0	33	58	0	0	0	0	8	0	0	16	8	16
51-60	0	0	0	17	25	-	-	-	-	-	0	0	0	33	16
61-70	0	0	0	0	17	-	-	-	-	-	0	0	0	17	25
71 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	18

Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-10	100	0	0	0	0	95	0	0	0	0	95	100	62	25	12	100	73	10	0	0	100	100	NA	60	28
11-20	0	89	25	0	0	5	95	55	0	0	5	0	38	63	25	0	27	90	60	22	0	0	NA	40	57
21-30	0	11	25	33	0	0	5	36	55	27	0	0	0	12	50	0	0	0	40	22	0	0	NA	0	15
31-40	0	0	42	33	25	0	0	9	27	36	0	0	0	0	13	0	0	0	0	56	-	-	NA	-	-
41-50	0	0	8	25	33	0	0	0	18	10	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-
51-60	0	0	0	9	25	0	0	0	0	27	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-
61-70	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-
71 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	-	-

Betula nigra L.

See colour plate

Family	:	Betulaceae
English name	:	River birch
French name	:	Bouleau noir, bouleau des rivières
Synonym	:	<i>Betula rubra</i>
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree with a pyramidal growth habit can attain a height of 25 m and a width of 12 m. The crown is rounded and the trunk usually has branches beginning near the base.

The bark of young trees is pinkish, turning a cinnamon colour as it matures. It peels off in wide, irregular linear plates, giving the trunk a rough appearance found virtually nowhere else except in *B. davurica*.

The branches are thin, reddish-brown to dark cinnamon in colour. The young shoots are downy and verrucous.

The leaves are shiny and dark green in summer, turning golden yellow in the fall. The leaves, 4 to 8 cm long, are alternate, simple, oval, bright green above, but glaucous beneath. The pubescence, on the lower surface, is limited to the veins when the tree ages. The margin is coarsely double-toothed.

This species is monoecious. The seeds are borne in upright catkins; they mature in June.

ORIGIN AND DISTRIBUTION

The river birch is native to North America and is found throughout the southern United States: in eastern Florida, the Mississippi basin and the states bordering the Gulf of Mexico, as far as Texas. Further north, it can be found in Massachusetts, Wisconsin and Minnesota. It has been cultivated since 1736.

USE

Ornamental: This is a beautiful species which can be used alone or in groups on private property or in parks, golf courses, large open spaces and near rivers and streams. It is also used for renaturalization in the United States.

Its tolerance to boring insects and its ability to adapt to moist sites make this a highly prized birch. It provides a moderate degree of shade because of its small leaves.

REQUIREMENTS

This species adapts to moist sites, marshy areas and alluvial plains. It grows along rivers and streams, but also does well in garden soils.

It prefers acidic soils (pH 6.5 or less) and develops chlorosis of the leaves if the lime content of the soil is too high.

Growth is moderate to fast. It transplants easily compared to other birch species.

This species is heat-tolerant and requires good exposure to sunlight.

PATHOLOGY

This birch is relatively resistant to leaf miners and borers. The leaves are susceptible to iron chlorosis; stress factors, such as soil compaction, excessive salinity and a high pH, can worsen this problem.

The wood is brittle. During very wet weather, leaf spot can cause defoliation of the tree.

PROPAGATION

Seedlings: The seeds mature in late spring and are sown immediately. Germination is best in a substrate composed of moist mineral soil. The seeds of this species are sometimes attacked by *Sclerotinia betulae*.

The cones are harvested when still green and placed in bags to prevent dispersal of the seeds. Commercially available seed mixtures contain both seeds and scales. To improve the purity, you must shake the cones, collect the seeds and sieve them or clean them using the ventilation method. The seeds of this species lose their viability when stored; if stored for two years at 4°C with

a relative humidity of 16%, the germination rate is reportedly less than 22%.

Propagation by cuttings: According to some authors, propagation by softwood cuttings is possible if the cuttings are immersed in a solution of 1,000 ppm IBA and 50% ethanol. In the experiment cited, the cuttings were taken from 13-year-old parent plants and the rooting rate was 75%.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Schumacher, United States

Propagation site: Montreal Botanical Garden

Propagation technique: The seeds were sown in May 1983. The seedlings were potted in small pots in the summer of 1984 and grown in a frame until they were shipped in May 1985.

Inclusion in test network: Seedlings 30 cm high and 2 to 4 mm in diameter were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

In general, this species suffered very slight winter damage and mortality was very low.

Region 1

No winter damage and no mortality occurred at the two sites at L'Assomption or at the Sainte-Clotilde site.

At Sainte-Anne-de-Bellevue, all the seedlings suffered frost damage on a significant proportion of the previous year's shoot the fourth winter only. Slight damage appeared the other winters on 30% to 100% of the seedlings.

Region 2

No mortality occurred in this region.

At Deschambault, only one seedling suffered damage associated with mechanical breakage during the third winter.

At Sainte-Foy and at La Pocatière, only slight damage was observed four winters out of five on nearly half the seedlings.

Region 3

At Normandin, the trees suffered no damage for five years, except for two seedlings which exhibited frost damage on the stem tips in the second winter.

At Kapuskasing, several seedlings died during the first winter; this mortality was associated with a lack of growth during the year of establishment. Regeneration of growth following transplanting was more difficult at this site. More than 70% of the trees suffered no damage the first four winters. Damage associated with mechanical breakage occurred during the last winter only.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 4.46 m R2 = 4.12 m R3 = 2.16 m

At the L'Assomption on sand, Sainte-Clotilde, Sainte-Foy and Deschambault sites, annual growth was more than 1 m beginning in the second year. At the La Pocatière, Normandin and L'Assomption on clay sites, it was between 50 and 70 cm annually.

At the Kapuskasing site, growth was virtually nil for the first two years and very slow thereafter.

Categories

The average height of the trees after five years varied from one site to another:

5.01 - 6.00 m: Sainte-Clotilde and L'Assomption on sand
 4.01 - 5.00 m: Sainte-Foy and Deschambault
 3.01 - 4.00 m: Sainte-Anne-de-Bellevue, Normandin and La Pocatière
 2.01 - 3.00 m: L'Assomption on clay
 1.00 m and - : Kapuskasing

The height of the trees at Kapuskasing significantly lowered the average for region 3.

Betula nigra L.

Effect of pruning

This species required very little pruning.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 80.5 mm R2 = 64.3 mm R3 = 34.5 mm

Categories

The average diameter of the trees after five years varied from one site to another:

101 mm and +: L'Assomption on sand
 81 - 100 mm : -
 61 - 80 mm : Sainte-Clotilde, L'Assomption on clay,
 Deschambault, Sainte-Foy and Sainte-
 Anne-de-Bellevue
 51 - 60 mm : La Pocatière
 41 - 50 mm : Normandin
 25 mm and - : Kapuskasing

The trees at L'Assomption on sand were particularly large.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

It took three years to obtain a trunk diameter of between 50 and 60 mm at the L'Assomption on sand, L'Assomption on clay and Sainte-Clotilde sites. A fourth year was needed for the trees at Sainte-Anne-de-Bellevue, Sainte-Foy and Deschambault to reach a comparable diameter. After five years, between 50% and 58% of the trees at Normandin and La Pocatière had attained this diameter, while those at Kapuskasing varied between 10 and 30 mm.

After three years, all the trees at L'Assomption on sand, Sainte-Clotilde and Sainte-Foy had attained a height of between 2 and 4 m. A fourth year was needed at the Deschambault, La Pocatière and Normandin sites, and a fifth year at the L'Assomption site on clay to obtain trees of equivalent height. At Kapuskasing, the height of the trees did not exceed 2 m.

This species can be successfully produced from the Montreal region to the Quebec City region.

Its growth is clearly poorer on clay soils and there would be no economic advantage to producing this species in the Kapuskasing region, where the trees were smaller and annual growth was virtually nil.

Use

This species, about whose behaviour in Quebec little was known, suffered very little damage at all the test sites. Hence, the zone rating for this species appears to be at least 2a; the experimental protocol did not enable us to evaluate its potential in zone 1. However, its growth was very poor in zone 2a.

BIBLIOGRAPHICAL REFERENCES

2, 3, 7, 21, 27, 47, 48, 57, 71, 89, 101, 103

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Michel Auger, Tech.

Table 1: Frequency of winter damage observed on *Betula nigra* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	100									0	
L'Assomption-sand	100									0	
Ste-Anne-de-Bellevue	20	54	20						6	80	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	98							2		2	
Sainte-Foy	45	53	2							55	
La Pocatière	44	56								56	
REGION 3											
Normandin	98	2								2	
Kapuskasing	77	2	1		4				16	23	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 5, 6, 7 and 9 occurred in this species.

Table 2: Breakdown of *Betula nigra* seedlings by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	95	0	0	0	0	90	0	0	0	0	62	0	0	0	0	67	5	0	0	0
11-20	5	5	0	0	0	10	29	0	0	0	38	0	0	0	0	33	48	0	0	0
21-30	0	85	0	0	0	0	71	8	0	0	0	62	0	0	0	0	47	0	0	0
31-40	0	10	0	0	0	0	0	42	8	0	0	38	0	0	0	0	0	50	8	0
41-50	0	0	0	0	0	0	0	42	8	17	0	0	8	0	0	0	0	50	0	8
51-60	0	0	58	0	0	0	8	34	8	0	0	67	8	0	0	0	0	0	42	25
61-70	0	0	42	0	0	0	0	0	42	17	0	0	25	67	34	0	0	0	50	50
71-80	0	0	0	17	0	0	0	0	0	33	0	0	0	17	33	0	0	0	0	17
81 and +	0	0	0	83	100	0	0	0	8	25	0	0	0	8	33	-	-	-	-	-

Table 2: Breakdown of *Betula nigra* seedlings by marketable trunk diameter category from 1985 to 1989 (cont'd)

Trunk diameter (mm)	REGION 2															REGION 3											
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking						
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89		
0-10	24	0	0	0	0	19	0	0	0	0	100	0	0	0	0	100	5	0	0	0	0	100	100	70	0	0	
11-20	76	10	0	0	0	81	5	0	0	0	0	100	0	0	0	0	0	95	42	0	0	0	0	0	30	70	50
21-30	0	85	0	0	0	0	80	8	0	0	0	0	83	0	0	0	0	58	17	8	0	0	0	0	30	40	
31-40	0	5	8	0	0	0	15	50	8	0	0	0	17	33	0	0	0	0	75	0	0	0	0	0	0	10	
41-50	0	0	84	0	0	0	0	42	17	8	0	0	0	67	42	0	0	0	8	42	-	-	-	-	-	-	
51-60	0	0	8	42	8	0	0	0	42	17	0	0	0	0	50	0	0	0	0	50	-	-	-	-	-	-	
61-70	0	0	0	58	34	0	0	0	25	17	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	
71-80	0	0	0	0	50	0	0	0	8	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
81 and +	0	0	0	0	8	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3: Breakdown of *Betula nigra* seedlings by marketable height category from 1985 to 1989

Height (cm)	REGION 1															REGION 2										REGION 3																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue					Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-100	100	0	0	0	0	100	14	0	0	0	81	0	0	0	0	100	24	0	0	0	0	100	100	100	100	80																			
101-200	0	100	0	0	0	0	86	75	17	8	19	43	0	0	0	0	76	67	0	0	0	0	0	0	0	20																			
201-300	0	0	67	0	0	0	0	25	83	25	0	57	33	0	0	0	0	33	50	25	-	-	-	-	-																				
301-400	0	0	33	17	0	0	0	0	0	67	0	0	67	42	0	0	0	0	50	67	-	-	-	-	-																				
401-500	0	0	0	83	0	-	-	-	-	-	0	0	0	58	0	0	0	0	8	-	-	-	-	-	-																				
501-600	0	0	0	0	100	-	-	-	-	-	0	0	0	0	92	-	-	-	-	-	-	-	-	-	-																				
601-700	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-																				

Betula pendula Roth

See colour plate

Family	:	Betulaceae
English name	:	European white birch
French name	:	Bouleau européen, bouleau blanc
Synonym	:	<i>Betula verrucosa</i> Ehrh., <i>Betula alba</i> L.
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree can attain a height of 15 to 20 m standing alone and 35 m or more in forested areas. It has a conical or pyramidal habit when young, becoming oval as it ages. This species is often used as a multi-stemmed tree.

The young bark is brown, turning white, then black with cracks when mature. It peels off far less than the bark of the paper birch. The bark is the most important ornamental attraction of this species.

The tips of the branches are generally drooping and their bark is smooth, resinous and glandular.

The leaves are light, greenish-yellow in the spring, turning yellow in the fall. The leaves are alternate and simple, generally ovate, truncated at the base, thin, tapered at the tip and double-toothed. The young leaves are sticky. When mature, they are 2 to 7 cm in length. The upper surface is glabrous and dark green and the lower surface is paler.

This species is monoecious. The male flowers are borne gracefully in pendulous catkins. Formed in the fall, they grow and distribute their pollen the following spring, when the female flowers appear in the form of erect catkins.

The seeds are dispersed in the fall.

ORIGIN AND DISTRIBUTION

This birch of European origin has a range extending as far as Japan.

It can be found in North America, occasionally in Nova Scotia and Wisconsin, as well as in New England and Iowa.

USE

Ornamental: The weeping branches, accentuated by flowering, make this tree interesting either as a solitary individual or in a group. It provides light shade.

REQUIREMENTS

This species adapts relatively well to poor conditions in urban areas. It is a relatively short-lived tree and loses its vigour after 25 or 30 years, even in ideal conditions. It lives longer in a moist area, such as in a sandy pit or in rich, well-drained soil. It prefers sunny sites.

It is transplanted in the spring and new growth regenerates relatively easily.

PATHOLOGY

Very sensitive to the birch miner [*Fenusa pusilla* (Lep.)] and to aphid attacks, this species requires attentive maintenance and prompt intervention to control infestations by insect pests. It can also be seriously affected by the birch borer (*Agilus anxius* Gory).

PROPAGATION

Seedlings: The seeds mature in the spring and must be sown immediately. The cones are harvested in the fall when still green and placed in bags to prevent dispersal of the seeds. They must be dried for several weeks so that excess humidity does not cause the seeds to deteriorate. Commercially available mixtures contain both seeds and scales. To improve the purity, you must shake the cones, collect the seeds and sieve them or clean them using the ventilation method.

The seeds of this species can be preserved for more than two years if kept in a sealed container and stored at between 0° and 8°C.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden

Propagation site: Montreal Botanical Garden

Propagation technique: The seeds were harvested on October 20, 1982 from a parent plant that was about 20 years old. They were sown in a frame on April 10, 1983. The seedlings were potted in Melfert® plugs in the summer of 1984 and grown in a frame until the spring of 1985.

Inclusion in test network: Young seedlings 15 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

This species proved to be quite hardy at all the sites. Winter damage was very slight and was limited to frost damage on the tips of the previous year's shoot.

Region 1

No damage occurred on the seedlings during the five years, except at Sainte-Anne-de-Bellevue. At this site, frost damage on the tips of the previous year's shoot was observed the first four years. One seedling died the third year.

Region 2

At Deschambault, the data were collected the second, fourth and fifth years, and no damage was observed. At Sainte-Foy, slight damage was observed following the first three winters, while at La Pocatière, half the trees suffered slight frost damage during the second winter only.

Region 3

At Normandin, only one tree suffered frost damage on the branch tips in the second year.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 5.61 m R2 = 5.38 m R3 = 3.26 m

Categories

The average height of the trees after five years varied from one site to another:

6.01 - 7.50 m: Sainte-Clotilde
 5.01 - 6.00 m: Deschambault, Sainte-Foy, Sainte-Anne-de-Bellevue and L'Assomption on sand
 4.01 - 5.00 m: Normandin, L'Assomption on clay and La Pocatière
 2.01 - 3.00 m: Kapuskasing

The Kapuskasing station brought down the average for region 3, and L'Assomption on clay the average for region 1. The trees at Sainte-Clotilde were the highest, from the first year of growth.

Effect of pruning

This species required very little pruning.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 103 mm R2 = 90 mm R3 = 62 mm

Categories

The average trunk diameter of the trees after five years varied from one site to another:

101 - 115 mm: L'Assomption on sand, Sainte-Clotilde and L'Assomption on clay
 91 - 100 mm : Sainte-Anne-de-Bellevue and Sainte-Foy
 81 - 90 mm : Deschambault and La Pocatière
 71 - 80 mm : Normandin
 41 - 60 mm : Kapuskasing

A growth gradient was observed from region 1 to region 3 and the trees were clearly smaller at Kapuskasing.

In proportion to their height, the trees at L'Assomption on clay and at L'Assomption on sand have a very large trunk diameter.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

***Betula pendula* Roth**

Production

After two years, 70% to 80% of the trees at the L'Assomption on sand, Sainte-Clotilde and Deschambault sites had attained a trunk diameter of between 30 and 50 mm. This figure was 62% for the L'Assomption site on clay, and 48% for the Sainte-Anne-de-Bellevue and Sainte-Foy sites for the same period. After a third year, the seedlings at Normandin and La Pocatière had attained this diameter, while those at Kapuskasing required an additional year.

After three years, all the trees at Sainte-Clotilde had attained a height of between 3 and 5 m, and 75% to 100% of the trees at Sainte-Foy and Deschambault had attained a height of between 3 and 4 m. This figure was 50% for the Sainte-Anne-de-Bellevue site. An additional year was needed at the two L'Assomption sites, at La Pocatière and at Normandin for all the seedlings to reach this category of production. At Kapuskasing, even after five years, the trees did not exceed 2 to 3 m.

The best region for producing this species is the southern Montreal region, where the weather is milder; this is reflected in the tree diameter, which is clearly greater. Production is also possible in the Quebec City region, but growth there is a little slower. The growth in height at the sites with clay soil was also slower. At the sites where production was better, growth was significant right from the first year.

Use

This species suffered no damage at the northernmost test site (Kapuskasing); a zone rating of 1b was therefore assigned for its use. However, this tree grows more slowly in colder regions.

BIBLIOGRAPHICAL REFERENCES

2, 3, 7, 12, 21, 27, 60, 71, 89, 101, 103

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Isabelle Duchesne, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Betula pendula* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	100									0
L'Assomption-sand	100									0
Ste-Anne-de-Bellevue	40	58				2				60
Sainte-Clotilde	100									0
REGION 2										
Deschambault ^b	100									0
Sainte-Foy	63	37								37
La Pocatière	90	10								10
REGION 3										
Normandin	99	1								1
Kapuskasing	100									0

^a Key: 1 = no damage
 2 = damage to the tip of 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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 to 7 and 9 to 11 occurred in this species.

^b The data are based on three years only.

Table 2: Breakdown of *Betula pendula* seedlings by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	90	0	0	0	0	52	0	0	0	0	29	0	0	0	0	29	0	0	0	0
11-20	10	5	0	0	0	48	0	0	0	0	71	0	0	0	0	71	0	0	0	0
21-30	0	24	0	0	0	0	38	0	0	0	0	14	0	0	0	0	52	0	0	0
31-40	0	57	0	0	0	0	62	0	0	0	0	62	0	0	0	0	48	0	0	0
41-50	0	14	0	0	0	0	0	8	0	0	0	24	0	0	0	0	0	9	0	0
51-60	0	0	25	0	0	0	0	25	0	0	0	0	17	0	0	0	0	67	0	0
61-70	0	0	25	0	0	0	0	67	8	0	0	0	17	0	0	0	0	24	9	0
71-90	0	0	50	58	8	0	0	0	67	17	0	0	58	50	0	0	0	0	73	18
91 and +	0	0	0	42	92	0	0	0	25	83	0	0	8	50	100	0	0	0	18	82

Table 2: Breakdown of *Betula pendula* seedlings by marketable trunk diameter category from 1985 to 1989 (cont'd)

Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	100	5	0	0	0	100	0	0	0	0
11-20	100	0	0	0	0	95	0	0	0	0	0	62	0	0	0	0	62	8	0	0	0	100	42	0	0
21-30	0	52	0	0	0	5	24	0	0	0	0	38	0	0	0	0	33	17	0	0	0	0	50	8	0
31-40	0	48	0	0	0	0	71	8	0	0	0	0	50	0	0	0	0	67	17	0	0	0	8	25	17
41-50	0	0	0	0	0	0	5	25	0	0	0	0	50	0	0	0	0	8	8	17	0	0	0	59	33
51-60	0	0	42	0	0	0	0	67	17	0	0	0	0	17	0	0	0	0	17	0	0	0	0	8	50
61-70	0	0	41	8	0	0	0	0	0	0	0	0	0	58	8	0	0	0	50	17	-	-	-	-	-
71-90	0	0	17	67	33	0	0	0	83	42	0	0	0	25	67	0	0	0	8	50	-	-	-	-	-
91 and +	0	0	0	25	67	0	0	0	0	58	0	0	0	0	25	0	0	0	0	16	-	-	-	-	-

Table 3: Breakdown of *Betula pendula* seedlings by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	100	0	0	0	0	100	0	0	0	0	86	0	0	0	0	100	0	0	0	0
101-200	0	95	0	0	0	0	67	0	0	0	14	10	0	0	0	0	67	8	8	8
201-300	0	5	67	0	0	0	33	50	0	0	0	85	0	0	0	0	33	42	0	0
301-400	0	0	33	33	0	0	0	50	83	0	0	5	33	8	0	0	0	42	17	0
401-500	0	0	0	67	8	0	0	0	17	92	0	0	67	92	0	0	0	8	50	0
501-600	0	0	0	0	83	0	0	0	0	8	0	0	0	0	17	0	0	0	25	50
601-700	0	0	0	0	9	-	-	-	-	-	0	0	0	0	58	0	0	0	0	42
701-800	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	90	0	0	0	0	62	0	0	0	0	100	0	0	0	0	100	5	0	0	0	100	90	0	0	0
101-200	10	14	0	0	0	38	10	0	0	0	0	100	0	0	0	0	38	8	0	0	0	10	100	58	25
201-300	0	86	0	0	0	0	90	25	0	0	0	0	83	0	0	0	57	42	8	0	0	0	0	42	75
301-400	0	0	100	8	0	0	0	75	17	0	0	0	17	33	8	0	0	50	75	17	-	-	-	-	-
401-500	0	0	0	92	17	0	0	0	75	0	0	0	0	67	84	0	0	0	17	41	-	-	-	-	-
501-600	0	0	0	0	75	0	0	0	8	58	0	0	0	0	8	0	0	0	0	42	-	-	-	-	-
601-700	0	0	0	0	8	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
701-800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Betula pendula Roth

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously for the 1985-90 planting.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Karelskaya, Russia

Propagation site: Agriculture and Agri-Food Canada Research Farm, L'Assomption, Quebec

Propagation technique: The seeds, which were harvested in 1981, were received on October 18, 1983. They were sown on November 2 in a frame with 63% shade. On May 10, 1984, the germination rate was 33%. After thinning, carried out on July 4, 1985, the young seedlings were left in the frame until October 18, when they were dug up and heeled in until April 3, 1986; they were 54 cm high at that time. They were cut back by 15 to 20 cm, put in plastic bags and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 15 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

At six of the eight sites, mortality on planting ranged from 5% to 24%.

This species suffered very little winter damage.

Region 1

No major damage affected the seedlings at the three sites in this region. The second winter, one seedling died at L'Assomption on sand and three seedlings suffered damage by rodents at the site on clay.

Region 2

No severe damage affected the seedlings at Sainte-Foy and at La Pocatière. At Sainte-Foy, a single seedling

exhibited frost damage on the stem tips the fourth winter. At La Pocatière, 17% of the seedlings suffered frost damage on part of the previous year's shoot the last winter.

At Deschambault, the number of undamaged seedlings varied from 67% to 91%, depending on the year. Between 8% and 25% of the seedlings suffered mechanical breakage, caused by the weight of the snow, annually. Two seedlings died during testing, one during the fourth winter and the other the following winter, the latter having suffered very severe mechanical damage the previous year. As well, 18% of the seedlings suffered frost damage on the stem tips the last winter.

Region 3

No damage and no mortality occurred at the Normandin and Kapuskasing sites.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.60 m (4.10 m) R2 = 3.29 m (3.65 m)
R3 = 2.58 m (2.68 m)

There was considerable variability between the specimens evaluated, and the final average by site includes the slow-growing individuals. The figure in parentheses is the final height of the faster-growing specimens.

Categories

The average height of the trees after five years varied from one station to another:

4.01 - 5.00 m: Sainte-Clotilde
3.01 - 4.00 m: L'Assomption on sand, Sainte-Foy, Deschambault and Normandin
2.01 - 3.00 m: L'Assomption on clay and La Pocatière
1.01 - 2.00 m: Kapuskasing

There was considerable variability among the individuals from the seedlings of this provenance; 17% to 33% of the seedlings evaluated at each site were clearly slower growing.

The final height provided in these categories includes the slower-growing seedlings, which lowered the potential final height by 6% to 17%, depending on the site.

Effect of pruning

This species required only slight pruning for shaping.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 73 mm R2 = 64 mm R3 = 52 mm

The seedlings at the L'Assomption on clay and Kapuskasing sites brought down their respective regional averages.

Categories

The average diameter of the trees after five years varied from one station to another:

81 mm and +: L'Assomption on sand and Sainte-Clotilde
 71 - 80 mm : Deschambault
 61 - 70 mm : Sainte-Foy and Normandin
 51 - 60 mm : L'Assomption on clay and La Pocatière
 41 - 50 mm : Kapuskasing

For this growth parameter, variability among the seedlings was far less evident than was observed for height.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable seedlings by category at each test site, for the final height and trunk 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 predetermined diameter or height.

Production

The plants from the seedlings of this provenance showed considerable variability and Table 2 provides a breakdown of the seedlings by year. At the more northerly sites, this variation among seedlings was far less evident; the average final height was lower.

After three years of production, more than 60% of the seedlings had a height of 2 m or more at the Sainte-Foy, Sainte-Clotilde and Normandin sites. This figure was between 42% and 33% respectively at the L'Assomption

on sand and Deschambault sites for the same period. It is therefore possible to produce this species at several sites in regions 1 and 2.

Use

The trees from this provenance are very well adapted to the winter weather conditions of the entire territory under study; a zone rating of 2a, which is considered conservative, was assigned.

However, seedling growth was slower from zone 4a northward. The trees in zone 2a attained a height of 2 to 3 m after five years of production, which made it possible to evaluate their potential.

There is no risk in using seedlings from this provenance throughout Quebec.

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Table 1: Frequency of winter damage observed on *Betula pendula* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	97								3		3
L'Assomption-sand	99					1					1
Sainte-Clotilde	100										0
REGION 2											
Deschambault	81	4				4		11			19
Sainte-Foy	99	1									1
La Pocatière	97		3								3
REGION 3											
Normandin	100										0
Kapuskasing	100										0

^a Key: 1 = no damage
 2 = damage on the tip of 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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 5, 6, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Betula pendula* seedlings by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	95	26	8	8	0	100	44	17	0	0	95	10	0	0	0
101-200	5	69	50	0	9	0	50	75	42	33	5	66	33	0	0
201-300	0	5	42	67	8	0	6	0	42	25	0	19	42	33	25
301-400	0	0	0	25	50	0	0	8	16	25	0	5	17	25	17
401-500	0	0	0	0	33	0	0	0	0	17	0	0	8	25	25
501-600	-	-	-	-	-	-	-	-	-	-	0	0	0	17	17
601-700	-	-	-	-	-	-	-	-	-	-	0	0	0	0	16
Height (cm)	REGION 2														
	Sainte-Foy					Deschambault					La Pocatière				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	83	17	0	0	0	95	40	17	8	9	100	100	8	8	0
101-200	17	61	27	9	0	5	60	50	33	18	0	0	92	9	8
201-300	0	22	55	36	18	0	0	33	50	9	0	0	0	83	50
301-400	0	0	18	45	36	0	0	0	9	46	0	0	0	0	42
401-500	0	0	0	10	36	0	0	0	0	18	-	-	-	-	-
501-600	0	0	0	0	10	-	-	-	-	-	-	-	-	-	-
601-700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Height (cm)	REGION 3														
	Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90					
0-100	100	31	0	0	0	100	100	17	0	0					
101-200	0	69	36	9	0	0	0	83	100	58					
201-300	0	0	64	55	36	0	0	0	0	42					
301-400	0	0	0	36	55	-	-	-	-	-					
401-500	0	0	0	0	9	-	-	-	-	-					
501-600	-	-	-	-	-	-	-	-	-	-					
601-700	-	-	-	-	-	-	-	-	-	-					

Table 3: Breakdown of *Betula pendula* seedlings by marketable trunk diameter category from 1986 to 1990

Trunk diameter (mm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	32	0	0	0	100	77	17	8	0	100	10	0	0	0
21-40	0	68	50	0	0	0	33	75	17	9	0	85	17	0	0
41-60	0	0	50	33	16	0	0	0	67	58	0	5	58	34	17
61-80	0	0	0	58	17	0	0	8	0	25	0	0	25	42	33
81 and +	0	0	0	9	67	0	0	0	8	8	0	0	0	24	50

Trunk diameter (mm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-21	100	63	0	0	0	100	65	17	8	9	100	100	8	0	0	100	69	0	0	0	100	100	NA	0	0
21-40	0	37	72	27	18	0	35	75	16	18	0	0	92	58	8	0	31	100	45	0	0	0	NA	100	33
41-60	0	0	28	55	36	0	0	8	76	0	0	0	0	42	83	0	0	0	36	73	0	0	NA	0	67
61-80	0	0	0	18	28	0	0	0	0	37	0	0	0	0	9	0	0	0	19	9	-	-	NA	-	-
81 and +	0	0	0	0	18	0	0	0	0	36	-	-	-	-	-	0	0	0	0	18	-	-	NA	-	-

Calluna vulgaris 'Alportii'

See colour plate

Family	:	Ericaceae
English name	:	Scotch heather
French name	:	Bruyère, callune
Category	:	Evergreen plant
Subdivision	:	Climbing or creeping plant

BOTANICAL DESCRIPTION

This creeping shrub, with an erect growth habit, can reach a height of 0.4 m and a width of 1 m. The foliage is grey-green.

The stems are very thin, cylindrical, the central parts are very small, round and continuous. The buds are small, solitary, spherical or angular in shape and covered by three scales.

The leaves are opposite, simple, persistent, with four rows of scales, which give the shoot a squared shape. They are sessile, oblong-ovate and are 2 to 5 mm long. They are medium green in colour in the summer, varying from green to bronze in the winter.

The flowers, grouped into spikes, appear between mid-July and mid-August on the year's shoot. The colour ranges from purplish-pink to crimson red.

The dried flowers remain on the plant for a very long time.

ORIGIN AND DISTRIBUTION

The range of this species covers Europe and Asia Minor. It is found in small populations in North America and in eastern Canada. This cultivar originates in England.

The species was introduced to Canada in 1840 by Sir William Hooker.

USE

Ornamental: This cultivar is used in groups, with other Ericaceae, for its dense and long-lasting flowers and its

decorative foliage. Higher and more vigorous than the other *Callunas*, it is an excellent ground cover used for borders and in rock gardens.

REQUIREMENTS

The species prefers poor and acidic soils with a pH of 6 or less, sandy or organic, but very well drained. It grows better sheltered from the wind and in full sunlight. This cultivar tolerates slight shade but flowering is less abundant.

To encourage the plant to grow as a shrub and stimulate flowering, it is necessary to prune in early spring, just before the resumption of plant growth or after flowering.

PATHOLOGY

Certain insects can affect *Callunas*, such as the Japanese beetle and the two-spotted mite.

PROPAGATION

Seedlings: The seeds can be sown in peat and germinate in less than two or three weeks.

Layering: Propagation by this technique produces a limited number of plants.

Propagation by cuttings: The cuttings can be treated with a hormonal solution of 1,000 ppm IBA. They take root in two or three weeks.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Oka, Quebec

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

Propagation technique: 5 cm cuttings were taken on July 7, 1983 from four to five year-old parent plants. They were treated with a 4,000 ppm IBA solution. They were placed in a mist propagator on a substrate composed of equal parts peat and perlite. The rooting rate was 99% on July 25. On August 4, the plants were potted in small pots. From October 21, 1983 to April 24, 1984, the cuttings were placed in a cold store at 5°C and at 60% relative humidity, under conditions of artificial light eight hours a day. The plants were placed in a greenhouse from April 24 to June 13 and then placed outside until May 1985.

Inclusion in test network: Young plants 10 to 15 cm high and wide were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

At most of the test sites, the plants were undamaged following the first two winters.

Mortality occurred at all the sites, except Sainte-Clotilde and Deschambault.

Region 1

At L'Assomption on sand, no damage occurred during the testing, with the exception of one plant that died following the fourth winter. At the site with clay soil, damage was apparent particularly during the last two winters, when 8% and 20% of the plants suffered frost damage on the stem tips and 15% and 40% of the plants died.

At Sainte-Clotilde, all the plants suffered frost damage on the entire previous year's shoot following the third and fourth winters. However, they were undamaged three winters out of five.

At Sainte-Anne-de-Bellevue, all the plants in the third replication died following the second, third and fourth winters. With the exception of these plants, frost damage on the old wood occurred following the third winter on 70% of the plants and stem tip frost damage occurred on the other plants the last three years.

Region 2

At Sainte-Foy and at Deschambault, all the plants suffered browning of the foliage following the fourth winter. The last winter, 42% of the plants suffered frost damage on the old wood at Sainte-Foy and 33% of the plants again exhibited browning at Deschambault.

At La Pocatière, rodents damaged 50% of the plants the third winter and more than 50% of the plants suffered browning of the foliage the last two winters.

Region 3

At Normandin, all the plants died following the second winter. This mortality is apparently largely attributable to the pedological conditions of the site.

At Kapuskasing, a high percentage (67% to 93%) of the plants did not suffer any damage following the first, fourth and fifth winters; 78% of the plants exhibited foliage browning the second winter and a few plants died following the first, third and fourth winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.30 m R2 = 0.36 m R3 = 0.21 m*

* This figure represents the average of the plants at Kapuskasing.

The plants at Sainte-Clotilde clearly did better than those at the other sites in region 1 and the plants at La Pocatière did less well than those at the other sites in region 2.

Categories

The average height of the shrubs after five years showed little variation from one site to another:

0.41 m and +: Sainte-Clotilde, Sainte-Foy* and Deschambault
 0.31 - 0.40 m: Sainte-Anne-de-Bellevue
 0.21 - 0.30 m: L'Assomption on sand, L'Assomption on clay, La Pocatière and Kapuskasing

* This average was reported after the fourth year of testing.

There was no increase in growth in height at the two L'Assomption sites, at La Pocatière and at Kapuskasing during the final three or four years.

For Sainte-Foy and Deschambault, the average height of the plants in the fifth year was less than the previous year's height.

Effect of pruning

Pruning for this species was minimal. Only some pruning for shaping was needed the first few years.

Calluna vulgaris 'Alportii'

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.56 m R2 = 0.59 m R3 = 0.29 m*

* This figure represents the average of the plants at Kapuskasing.

The L'Assomption on clay and La Pocatière sites brought down their respective regional averages.

Categories

The average width of the shrubs after five years varied from one site to another:

0.76 m and +: Sainte-Clotilde
 0.66 - 0.75 m: Deschambault
 0.56 - 0.65 m: Sainte-Foy and Sainte-Anne-de-Bellevue
 0.46 - 0.55 m: L'Assomption on sand and La Pocatière
 0.36 - 0.45 m: -
 0.35 m and -: L'Assomption on clay and Kapuskasing

The width increased over the five-year period at the Sainte-Clotilde, Sainte-Anne-de-Bellevue and Deschambault sites only. At the L'Assomption on sand, Sainte-Foy and La Pocatière sites, the width remained constant the last two or three years. Furthermore, there was a decrease in the average width of the plants at L'Assomption on clay beginning in the third year and no growth the last four years at Kapuskasing.

Flowering

Flowering was generally quite abundant every year at all the sites, despite the winter frosts.

At the sites in region 1, the plants flowered the last four years. Flowering began between July 15 and 20 and lasted until the end of September or October, depending on how mild the fall weather was. The total duration of flowering ranged from 40 to 70 days and the peak flowering period lasted for 40 to 50 days.

At the sites in region 2, the first flowers appeared after July 28 but mainly around August 10. Flowering lasted until mid-September or late October depending on the year, i.e. 35 to 70 days.

In region 3, the first flowers were noted around mid-August and flowering continued until mid-October. The end of flowering often depended on the first major frosts and the duration of flowering varied from one region to another in relation to the appearance of the first flowers.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final width obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined width.

Production

The largest plants were obtained at Sainte-Clotilde. By the second year of growth, all the plants were between 30 and 60 cm wide. At the L'Assomption on sand, Sainte-Foy, Deschambault and La Pocatière sites, the plants were between 30 and 45 cm wide for the same period.

Production was faster in the southern Montreal region. Production is possible in the Quebec City region with an additional growing year and good snow cover.

Use

The zone rating of 6 for this species, mentioned by Sherk and Buckley, seems genuinely under-estimated. A zone rating of 4 seems more appropriate for this cultivar, especially if it is protected by snow cover. The test results demonstrate that more than 50% of the plants did not suffer any serious damage each year, with frost damage on the stem tips and browning of the foliage being the most serious damage. Furthermore, flowering was abundant from the second season.

At Kapuskasing (zone 2a), the snow cover certainly protected this cultivar but growth there was quite slow. The mortality at Normandin was probably related to unfavourable edaphic conditions.

BIBLIOGRAPHICAL REFERENCES

5, 18, 21, 27, 39, 46, 47, 57, 60, 64, 65, 71, 86

WRITTEN BY

Claude Richer, Agr.
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Jacques Côté, Biol.



Table 1: Frequency of winter damage observed on *Calluna vulgaris* 'Alportii' from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	80	5	2	2		11					20
L'Assomption-sand	98					2					2
Ste-Anne-de-Bellevue	35	40				9	14		2		65
Sainte-Clotilde	60		40								40
REGION 2											
Deschambault	67									33	33
Sainte-Foy	52	20				8				20	48
La Pocatière	53					2			10	35	47
REGION 3											
Normandin	20					80					80
Kapuskasing	54					13	5			28	46

- ^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 splitting |
| 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 types 3, 7 and 10 occurred for this species.

Table 2: Breakdown of *Calluna vulgaris* 'Alportii' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-15	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0					
16-30	95	0	0	8	9	90	76	0	10	50	38	0	0	0	0	76	38	0	0	11					
31-45	5	86	17	25	28	10	24	58	63	40	62	52	0	0	0	0	56	30	22	11					
46-60	0	14	50	42	27	0	0	42	27	10	0	48	8	0	0	0	6	70	68	56					
61-75	0	0	33	17	36	-	-	-	-	-	0	0	92	50	8	0	0	0	10	22					
76-90	-	-	-	-	-	-	-	-	-	-	0	0	0	50	75	-	-	-	-	-					
91 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-					
Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	14	0	0	0	10	0	7	0	0
16-30	100	14	0	0	0	100	0	0	0	0	100	0	17	0	9	67	81	0	0	0	90	90	57	78	63
31-45	0	86	8	8	8	0	95	8	0	0	0	95	66	64	27	0	5	0	0	0	0	10	36	22	37
46-60	0	0	75	17	50	0	5	67	50	8	0	5	17	36	64	-	-	-	-	-	-	-	-	-	-
61-75	0	0	17	75	42	0	0	25	50	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76-90	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
91 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Caragana arborescens Lam.

See colour plate

Family	:	Fabaceae
English name	:	Siberian pea tree
French name	:	Caragana de Sibérie
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This erect shrub with an open growth habit can reach a height of 5 to 6 m and a width of 4.5 m.

The young stems have olive green pubescent bark covered with pale horizontal lenticels. As they get older, the branches become yellowish.

The slightly overlapping buds are pale brown.

The foliage is light. The light green leaves are alternate, compound, with eight to twelve elliptic leaflets, rounded at the top and acuminate at the base. They are 1 to 2.5 cm long. When young, they are pubescent, but later become glabrous.

The papilionaceous flowers, single or in clusters of two, three or four, are fragrant and bright yellow. They are 1.5 to 2 cm in diameter and appear shortly after leafing, on the previous year's wood.

The fruits, or pods, are 4 to 5 cm long, are yellow-green and turn brown in July-August. They contain three to five seeds.

ORIGIN AND DISTRIBUTION

This species was discovered in 1752 and originates in the desolate, windswept regions of northern Asia, more specifically, the cold regions of Siberia and Mongolia.

USE

This shrub can be used to form a free hedge or pruned, in groups or as solitary individuals, as a screen or windbreak.

REQUIREMENTS

This species is not very demanding in terms of soil. It tolerates poor, alkaline and saline soils. It is very easy to cultivate and quite resistant to cold, drought and wind. It prefers a sunny exposure. Its growth is generally rapid.

PATHOLOGY

Nothing very serious attacks this species, apart from leaf miners which sometimes damage the young plants and aphids which occasionally affect it.

PROPAGATION

Seedlings: Stratification for 15 days or more at 4°C is recommended after soaking the seeds in cold or hot water. Scarification by a brief soaking (five minutes) in an acid would also be effective. It is also suggested to place the seeds in the ground in the fall and allow nature to take its course.

Propagation by cuttings: Several types of cuttings can be used for this species: leafy cuttings from young shoots, softwood cuttings from older branches or hardwood cuttings from leafless branches in late fall or winter.

Propagation can also be carried out by root cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: City of Montreal, Quebec

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

Propagation technique: The pods were harvested in the summer of 1982 and the seeds were extracted manually. They were sown in a greenhouse on June 1, 1983, after soaking in water for two weeks. After emergence, the seedlings were transferred to individual cells and placed outside until the fall. On June 6, 1984, they were transplanted to the nursery. In the spring of 1985, they were dug up, wrapped and stored until they were shipped in May.

Inclusion in test network: Young seedlings 12 to 15 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

This species was particularly resistant at all the stations. Mortality of a few seedlings was observed at Kapuskasing.

Region 1

No damage occurred at the stations in this region.

Region 2

Winter damage was very minimal: a small amount of breakage caused by the weight of the snow during the third and fourth winters at Deschambault, and frost damage on the stem tips of one seedling during the second winter at the Sainte-Foy and La Pocatière sites.

Region 3

At Normandin, only two seedlings suffered damage caused by the weight of the snow the first winter.

At Kapuskasing, 10% of the seedlings died the first winter and 55% the fourth winter. No other type of damage occurred at this site. Death of the seedlings could be attributed to frost damage on the roots, since no other damage was observed on the stems of the dead shrubs.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.91 m R2 = 2.03 m R3 = 1.66 m

The two L'Assomption sites brought down the average for their region. The height of the shrubs was lower in region 3.

Categories

The average height of the shrubs after five years varied from one site to another:

- 2.01 - 2.50 m: Sainte-Clotilde, Sainte-Anne-de-Bellevue, Deschambault and La Pocatière
- 1.51 - 2.00 m: Sainte-Foy, Normandin, L'Assomption on sand and L'Assomption on clay
- 1.01 - 1.50 m: Kapuskasing

Effect of pruning

This species required very little pruning.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.52 m R2 = 1.36 m R3 = 1.47 m

The width was similar regardless of the region. The seedlings at Normandin and at Kapuskasing were as high as they were wide.

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.51 - 1.75 m: Sainte-Anne-de-Bellevue, Normandin and L'Assomption on sand
- 1.26 - 1.50 m: Sainte-Foy, La Pocatière, Sainte-Clotilde, L'Assomption on clay and Kapuskasing
- 1.01 - 1.25 m: Deschambault

A halt in growth in width after the fourth year was observed only at the La Pocatière site.

Flowering

In region 1, the flowering period began between May 10 and 20. The duration of flowering varied from 15 to 20 days, and the peak flowering period lasted from 7 to 14 days.

In region 2, the flowers appeared between May 20 and 30, or some 10 days later. The flowers were present for 12 to 23 days, and the peak flowering period lasted from 10 to 16 days.

Caragana arborescens Lam.

BIBLIOGRAPHICAL REFERENCES

3, 22, 23, 27, 56, 57, 60, 86

In region 3, flowering began between May 25 and June 4, four or five days later than in region 2. The duration of the flowering period was similar to that in the Quebec City region.

All the seedlings flowered more abundantly during the last three years.

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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The production of plants using seedlings resulted in a certain heterogeneity and a few specimens exhibited very slow growth or a creeping growth habit. These seedlings were excluded from the results presented in these tables.

The shrubs at Sainte-Clotilde were higher every year, and particularly from the third year.

By the end of the second growing season, at all the sites, seedlings had attained a height ranging from 41 to 80 cm.

This species grows very quickly, adapts to all soil types and becomes established very early after planting. The results demonstrate that it is therefore possible to produce it in Quebec very competitively, except perhaps at a few locations, as the results at the L'Assomption on clay and Kapuskasing sites demonstrated.

Use

The zone rating of 2, assigned by Sherk and Buckley (1972), must be defined more precisely as 2b, given the high mortality of the seedlings at Kapuskasing during the fourth winter of testing.

This species can be used in zone 2a, and even as far north as zone 1, provided that the root system is well protected from the cold.

WRITTEN BY

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Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Caragana arborescens* from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	100									0	
L'Assomption-sand	100									0	
Ste-Anne-de-Bellevue	100									0	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	96							4		4	
Sainte-Foy	99	1								1	
La Pocatière	99	1								1	
REGION 3											
Normandin	98							2		2	
Kapuskasing	87					13				13	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 to 7, 9 and 11 occurred in this species.

Table 2: Breakdown of *Caragana arborescens* seedlings by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-40	53	5	0	0	0	42	6	0	0	0	0	0	0	0	0	62	5	0	0	0					
41-80	47	15	0	0	0	58	55	0	0	0	100	5	0	0	0	38	10	0	0	0					
81-120	0	80	18	9	0	0	39	70	40	0	0	65	0	0	0	0	80	8	0	0					
121-160	0	0	82	91	45	0	0	20	60	90	0	30	18	0	0	0	5	76	25	0					
161-200	0	0	0	0	55	0	0	10	0	10	0	0	82	100	100	0	0	16	75	100					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	5	0	0	0	0	15	0	0	0	0	85	5	0	0	0	19	5	0	0	0	100	5	0	0	0
41-80	95	5	0	0	0	85	50	0	0	0	15	38	0	0	0	76	37	0	0	0	0	83	0	0	0
81-120	0	75	8	8	0	0	40	18	0	0	0	57	33	0	0	5	58	58	0	0	0	12	82	0	20
121-160	0	20	67	8	8	0	10	82	18	9	0	0	67	25	0	0	0	42	67	0	0	0	18	100	60
161-200	0	0	25	84	92	0	0	0	82	91	0	0	0	75	100	0	0	0	33	100	0	0	0	0	20

Table 3: Breakdown of *Caragana arborescens* seedlings by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	90	5	0	0	0	79	17	0	0	0	100	0	0	0	0	90	10	0	0	0
41-80	10	80	9	9	0	21	78	30	10	0	0	90	0	0	0	10	71	42	8	0
81-120	0	15	82	18	0	0	5	70	80	10	0	10	90	55	9	0	19	58	33	8
121-160	0	0	9	73	73	0	0	0	10	60	0	0	10	36	63	0	0	0	59	25
161-200	0	0	0	0	27	0	0	0	0	30	0	0	0	9	28	0	0	0	0	67

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	95	0	0	0	0	80	10	0	0	0	100	0	0	0	0	100	10	0	0	0	100	17	9	0	0
41-80	5	67	8	0	0	20	85	36	0	0	0	85	8	0	0	0	67	0	0	0	0	72	63	0	0
81-120	0	23	67	58	8	0	0	64	63	72	0	15	67	16	50	0	23	75	17	0	0	11	28	63	40
121-160	0	10	25	25	67	0	5	0	37	28	0	0	25	8	33	0	0	25	83	58	0	0	0	37	60
161-200	0	0	0	17	25	-	-	-	-	-	0	0	0	76	17	0	0	0	0	42	-	-	-	-	-

Caragana spinosa (L.) DC

See colour plate

Family : Fabaceae
English name : Peashrub
French name : Caraganier
Category : Deciduous plant
Subdivision : Shrub

BOTANICAL DESCRIPTION

This shrub with an erect or prostrate growth habit can reach a height of more than 2 m.

With age, the branches open outward. The very thorny olive green branches are of two types: short or long.

The leaves are compound, with four to eight oblong lanceolate leaflets; these leaflets are 1.5 to 2 cm long and are borne on a short, rigid rachis which sometimes ends with a thorn. The leaves on the short branches have only four leaflets. Hairy when young, they become glabrous as they get older.

The light yellow flowers are 2 to 2.5 cm in diameter and are solitary. Flowering, in May and June, is abundant and the flowers are fragrant.

The pods, reddish brown when mature, are abundant and very decorative.

ORIGIN AND DISTRIBUTION

This species, originally from Siberia, was identified in 1775.

USE

Ornamental: This species can be planted singly or in groups, or used as a defensive hedge. In China, around Peking, its thorny branches were placed on the top of walls to prevent people from climbing over into the private gardens.

Naturalization: This species fixes nitrogen and can be used on steep slopes or along highways, on poor and polluted sites.

REQUIREMENTS

This shrub adapts to poor, dry and alkaline soils. It tolerates salinity and urban conditions quite well. Its growth is good.

PATHOLOGY

This species is generally problem-free. It is sometimes attacked by aphids, which can deform the young shoots.

PROPAGATION

Seedlings: The seeds can be stratified at 5°C or soaked in water for at least 15 days; the soaking can be begun with hot water. It is generally recommended that the seeds be sown outside in the fall.

Propagation by cuttings: Softwood cuttings can be taken in June and July and treated with concentrations of 3,000 to 8,000 ppm of IBA.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: City of Montreal, Quebec

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

Propagation technique: The seeds were sown in a greenhouse on June 1, 1983 after soaking in water for two weeks. In the fall, the seedlings were potted in individual cells, then placed outside where they overwintered. They were transplanted to the nursery on June 6, 1984. They were dug up in the spring of 1985 for shipment.

Inclusion in test network: Young seedlings 18 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Region 1

No damage was observed at the L'Assomption and Sainte-Clotilde sites. At Sainte-Anne-de-Bellevue, two seedlings suffered frost damage on the stem tips during the first winter.

Region 2

At Sainte-Foy, the percentage of undamaged seedlings ranged from 85% to 100% during the first four winters. Frost damage on the stem tips was observed on 33% of the seedlings the last winter.

At Deschambault, one seedling was damaged by mechanical breakage the third winter. At La Pocatière, one seedling suffered frost damage on the stem tip the second winter.

Region 3

No damage was observed at Normandin. At Kapuskasing, 15% of the seedlings died the second winter and all the others died following the fourth winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 2.02 m R2 = 2.19 m R3 = 1.95 m*

* This average is for the seedlings at the Normandin site only. The two sites at L'Assomption substantially brought down the average for region 1.

Categories

The average height of the shrubs after five years varied from one site to another:

2.51 m and +: Sainte-Clotilde
 2.26 - 2.50 m: Sainte-Anne-de-Bellevue and La Pocatière
 2.01 - 2.25 m: Sainte-Foy and Deschambault
 1.76 - 2.00 m: Normandin
 1.51 - 1.75 m: L'Assomption on sand and L'Assomption on clay

From the first year, the seedlings at Sainte-Clotilde were higher than those at the other sites.

Effect of pruning

The amount of pruning was approximately 50% the first year at all the sites. No pruning was necessary at Deschambault and at La Pocatière. It ranged from 20% to 30% at the L'Assomption and Normandin sites, and was not required at either Sainte-Foy or Sainte-Clotilde during the last year.

Growth in width

After five years, the average width for each region was:

R1 = 1.45 m R2 = 1.37 m R3 = 1.60 m*

* This average is for the seedlings at the Normandin site only.

Categories

The average width of the shrubs after five years showed little variation from one site to another:

1.51 - 1.75 m: Sainte-Anne-de-Bellevue, Normandin and Sainte-Foy
 1.26 - 1.50 m: L'Assomption on sand, Sainte-Clotilde, L'Assomption on clay, Deschambault and La Pocatière

There was little difference in width among the seedlings from one site to another.

As was the case for height, the seedlings at the Sainte-Foy site were among the widest during the first three years.

Effect of pruning

The amount of pruning was approximately 50% at all the sites following the first winter.

Flowering

The first flowers were observed between May 13 and 20 at the Sainte-Clotilde and Sainte-Anne-de-Bellevue sites, and five or six days later at the two L'Assomption sites.

***Caragana spinosa* (L.) DC**

At the sites in region 2, flowering began seven to ten days later than in region 1.

In region 3, the first flowers appeared on May 27 or 28, i.e. a week later than in region 2. The flowering period lasted from 10 to 13 days at all the sites.

Flowering was observed at all the sites from the third year of testing.

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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After two years of growth, almost all the seedlings at Sainte-Clotilde and at Sainte-Foy had attained a height greater than 1.00 m. A third year was necessary at all the other sites to obtain a comparable production.

This species has constant annual growth. A few plants have a weeping or prostrate habit; this tendency is apparent mainly beginning in the second or third year. The literature mentions that it is possible to obtain plants with a weeping habit when the plants are grown from seeds. The results confirm this statement since at certain sites, more than 25% of the plants were weeping.

Use

The zone rating of this species was not defined by Sherk and Buckley (1972). The results of the testing demonstrated that this species tolerates the climatic conditions in zone 2b quite well. Indeed, following a particularly harsh winter, the seedlings did not survive in zone 2a, while they did not suffer any damage in zone 2b and in the warmer zones.

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- Jacques-André Rioux, Agr.*
- Jacques Côté, Biol.*
- Marie-Fleurette Beaudoin, Biol.*

Table 1: Frequency of winter damage observed on *Caragana spinosa* from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
	1	2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	100									0
L'Assomption-sand	100									0
Ste-Anne-de-Bellevue	98	2								2
Sainte-Clotilde	100									0
REGION 2										
Deschambault	98							2		2
Sainte-Foy	89	11								11
La Pocatière	99	1								1
REGION 3										
Normandin	100									0
Kapuskasing ^b	70					30				30

- ^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 to 7, 9 and 11 occurred in this species.

- ^b All the seedlings died during the fourth winter.

Table 2: Breakdown of *Caragana spinosa* seedlings by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	67	0	0	0	0	85	0	0	0	0	10	5	0	0	0	76	0	0	0	0					
51-100	33	52	0	0	0	15	86	17	17	0	90	0	0	0	0	24	48	0	0	0					
101-150	0	48	92	50	8	0	14	75	83	42	0	95	25	0	0	0	52	33	8	0					
151-200	0	0	8	50	92	0	0	8	0	58	0	0	67	42	8	0	0	67	50	75					
201-250	-	-	-	-	-	-	-	-	-	-	0	0	8	58	50	0	0	0	42	25					
251-300	-	-	-	-	-	-	-	-	-	-	0	0	0	0	42	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	57	0	17	17	8	67	5	8	8	8	100	0	0	0	0	71	10	0	0	0	100	18	0	0	0
51-100	43	6	0	8	0	33	71	0	0	0	0	76	0	0	0	29	76	8	8	8	0	82	25	0	0
101-150	0	94	25	0	0	0	24	67	0	0	0	24	58	8	0	0	14	75	0	0	0	0	75	100	0
151-200	0	0	58	58	8	0	0	25	83	25	0	0	42	50	25	0	0	17	92	42	-	-	-	-	-
201-250	0	0	0	17	84	0	0	0	9	59	0	0	0	42	33	0	0	0	0	50	-	-	-	-	-
251-300	-	-	-	-	-	0	0	0	0	8	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Caragana spinosa* seedlings by marketable width category from 1985 to 1989

REGION 1																				
Width (cm)	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	14	8	0	0	95	67	0	0	0	100	14	0	0	0	100	24	0	0	0
51-100	0	86	83	50	0	5	33	92	58	0	0	86	58	25	8	0	76	75	0	0
101-150	0	0	9	50	58	0	0	8	42	92	0	0	42	67	75	0	0	25	83	8
151-200	0	0	0	0	42	0	0	0	0	8	0	0	0	8	17	0	0	0	17	83
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9

REGION 2										REGION 3															
Width (cm)	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	86	0	0	0	0	95	48	0	0	0	100	33	0	0	0	100	29	0	0	0	100	71	42	8	0
51-100	14	72	17	8	0	5	52	83	42	25	0	67	58	8	25	0	71	8	0	0	0	29	58	83	0
101-150	0	28	58	67	58	0	0	17	50	50	0	0	42	75	58	0	0	92	100	25	0	0	0	9	0
151-200	0	0	25	25	42	0	0	0	8	17	0	0	0	17	17	0	0	0	0	75	-	-	-	-	-
201-250	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Carpinus caroliniana var. *virginiana* (Marsh) Fern.

Family	:	Betulaceae
English name	:	American hornbeam, blue beech
French name	:	Charme d'Amérique
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This small tree or shrub can reach a height of 10 m, but when standing alone, it scarcely exceeds 3 to 4 m. The crown is low, rounded, wide and irregular. The broadly spreading and arched branches grow from a short, crooked trunk.

The bark is slate grey, smooth and thin. As the tree gets older, it becomes remarkable for its prominent longitudinal ridges which give the trunk a wavy outline.

The branches are frail, in flattened, spreading sprays. They are reddish-brown and their diameter does not exceed that of the leaf buds. The ovoid, reddish-brown buds are slightly pubescent and pressed against the branch. There is no terminal bud.

The simple, alternate leaves are 5 to 10 cm long and about half as wide. They are larger at the tip of the twig. They sometimes have tufts of white hairs at a right angle to the veins and their texture is firm to the touch. The blade is oval, acuminate and the margin is double-toothed. The foliage is bluish-green and glabrous when young and subsequently becomes dark. It turns red or orange in the fall. The leaves fall before the bracts.

This species is monoecious. The green drooping catkins develop in the spring. The sessile flowers are fully developed by the time of leafing.

The dry fruits, small nutlets, develop at the base of a leaf bract, thereby facilitating the dispersal of the seeds in the fall. The central lobe is toothed on one side only.

ORIGIN AND DISTRIBUTION

The etymological root of the genus name *Carpinus* is the Celtic words "car" and "pen" or "pin" which mean "wood" and "head". In Quebec, the expression "bois de fer" [ironwood] is used indiscriminately for the Charme de Caroline [blue beech] and the Ostryer de Virginie [ironwood or hop-hornbeam]. This species was described and named around 1812.

This indigenous species is found in the eastern and southeastern United States. It grows sparsely in the entire southern portion of the Great Lakes-St. Lawrence Forest Region and in the Deciduous Forest Region. It is also found in Central America and Mexico.

It has a lifespan of approximately 100 to 150 years.

USE

Ornamental: This small tree has very beautiful fall colours and magnificent bark. It can be used to form hedges or windbreaks, alone or in groups.

Wood use: Its wood is used to make tool handles. It is very heavy, hard and quite strong.

REQUIREMENTS

This species is very shade-tolerant. It is therefore often found growing in the understory of broadleaf forests, generally on deep, rich and moist soils, at the bottom of valleys and along rivers, streams and marshes. It does not tolerate overly acidic soils.

It is not easy to transplant and must be handled as a root ball or in a container. It does not tolerate pruning. Its annual growth is slow.

PATHOLOGY

To our knowledge, no serious disease appears to affect this species.

PROPAGATION

Seedlings: The seeds can be gathered in the fall when they are still greenish and sown immediately in moist soil. They can also be sown in the spring after stratification. The latter is also necessary if harvesting was late or if the seeds have dried out somewhat. Germination can then take two years. Once sown, the seeds must be covered with 1 to 2 cm of soil. The

young plantlets must be shaded during the first year of growth and cultivated for two years in a frame before transplanting.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Agriculture and Agri-Food Canada Research Farm, L'Assomption, Quebec

Propagation technique: The seeds, harvested in October 1983, were sown on November 2, in a frame with 63% shade. On May 18, 1984, the germination rate was 19%. The young seedlings were thinned on July 4, 1985 and at that time were 26 cm high. They were left in the frame until October 31, at which time they were dug up and heeled in until April 3, 1986. They were cut back to between 20 and 30 cm, wrapped in plastic bags and kept in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 20 to 30 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Frost damage was particularly high following the third winter at the sites in regions 1 and 2. Mortality of seedlings was noted at six of the eight test sites and was higher during the first two or three winters.

Region 1

At Sainte-Clotilde, two seedlings died the first two winters. One was a seedling that had attained little or no prior growth and the other had suffered mechanical damage the previous season. On average, more than 85% of the seedlings exhibited no damage each winter.

At L'Assomption on sand, no damage was observed during testing, with the exception of one seedling which suffered frost damage on the previous year's shoot the third winter.

At L'Assomption on clay, no damage was noted following the first three winters. Subsequently, 33% of

the seedlings suffered serious damage by rodents and did not survive the following winter.

Region 2

At Sainte-Foy, frost damage on the stem tips was observed every year on 20% to 100% of the seedlings.

At Deschambault, one seedling died during testing following the third winter. As well, 10% to 36% of the seedlings were damaged by mechanical breakage three winters out of five and 42% of the seedlings suffered frost damage on the stem tips the third winter.

At La Pocatière, mortality was very high following the second and third winters. Damage on the previous year's shoot was noted on 20%, 63% and 15% of the seedlings following the first, third and fourth winters. As well, frost damage on the stem tips affected 5%, 20% and 57% of the seedlings, depending on the year. No damage occurred the last winter.

Region 3

At Normandin, during the first three winters, three seedlings died and 5% to 36% of the seedlings suffered frost damage on the stem tips. During the second winter, 20% of the seedlings suffered frost damage on the previous year's shoot.

At Kapuskasing, mortality was 10% and 12% during the first two winters. The fourth winter, a larger number of seedlings were damaged: 27% of the seedlings suffered frost damage on the stem tips, 36% also suffered frost damage above the level of snow cover and 10% suffered mechanical breakage.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.09 m R2 = 2.07 m R3 = 1.26 m

Growth was poorer at the La Pocatière site, which brought down its regional average.

***Carpinus caroliniana* var. *virginiana* ...**

Categories

The average height of the trees after five years varied from one station to another:

- 2.51 m and + : Sainte-Clotilde, Deschambault and Sainte-Foy
 2.01 - 2.50 m: L'Assomption on clay
 1.51 - 2.00 m: L'Assomption on sand and Normandin
 1.01 - 1.50 m: La Pocatière
 1.00 m and - : Kapuskasing

The seedlings exhibited great variability among individuals.

Effect of pruning

Little pruning was done at the majority of sites.

Growth in width

The seedlings exhibited very irregular growth in width at each of the sites. The results for this parameter are therefore not presented.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable seedlings by category at each test site, for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

This species produced the best growth results at the Sainte-Clotilde, Sainte-Foy and Deschambault sites. After three years, the number of seedlings more than 1.51 m high was 67%, 63% and 34% respectively at these three sites. This species can therefore be produced in the Montreal and Quebec City regions, but the seedlings are susceptible to frost damage on the stem tips in the Quebec City region.

Use

When the young seedling suffers severe damage caused by frost, mechanical breakage or rodents, it has great difficulty recovering.

The zone rating of 3b assigned by Buckley can be modified to 2b. Indeed, the seedlings tested at Normandin (zone 2b) exhibited very good growth and relatively little damage.

However, although the seedlings at Kapuskasing (zone 2a) did not exhibit significant mortality, they developed very slowly and suffered fairly severe damage on the parts not protected by snow.

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5, 12, 13, 16, 20, 27, 47, 49, 51, 57, 65, 83, 84, 101

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Carpinus caroliniana* var. *virginiana* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	86					7			7		14
L'Assomption-sand	98		2								2
Sainte-Clotilde	94	2	2			2					6
REGION 2											
Deschambault	68	12				4		16			32
Sainte-Foy	47	53									53
La Pocatière	48	17	23			11			1		52
REGION 3											
Normandin	76	16	4			4					24
Kapuskasig	65	20		7		6		2			35

- ^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 splitting |
| 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 types 3, 5, 7, 9 and 14 occurred for this species.

Table 2: Breakdown of the seedlings of *Carpinus caroliniana* var. *virginiana* by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	86	14	8	0	0	90	9	0	0	0	81	10	0	0	0
51-100	14	71	8	33	17	10	71	42	33	13	19	55	0	0	0
101-150	0	15	67	58	17	0	20	50	17	0	0	35	33	9	0
151-200	0	0	17	9	58	0	0	8	42	38	0	0	58	25	0
201-250	0	0	0	0	8	0	0	0	8	37	0	0	9	58	42
251-300	-	-	-	-	-	0	0	0	0	12	0	0	0	8	50
301 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	95	0	0	0	0	81	0	0	0	0	100	83	27	14	14	95	50	18	0	0	100	80	27	9	9
51-100	5	60	0	0	0	19	57	8	0	0	0	17	73	57	43	5	50	36	9	9	0	20	73	73	36
101-150	0	40	36	8	0	0	38	58	0	0	0	0	29	29	0	0	18	64	27	0	0	0	18	55	
151-200	0	0	55	33	8	0	5	34	36	0	0	0	0	14	0	0	28	27	55	-	-	-	-	-	
201-250	0	0	9	51	42	0	0	0	46	36	-	-	-	-	0	0	0	0	9	-	-	-	-	-	
251-300	0	0	0	8	42	0	0	0	18	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
301 and +	0	0	0	0	8	0	0	0	0	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Celtis occidentalis L.

See colour plate

Family	:	Ulmaceae
English name	:	Common hackberry
French name	:	Micocoulier occidental
Synonym	:	<i>Celtis crassifolia</i> Lam.
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

In Quebec, this tree with a spreading growth habit can reach a height of 20 m and a width of 18 m. The rounded crown is composed of ascending arching branches, often with drooping branchlets.

The bark is greyish-brown, very rough, verrucous and hard. Narrow ridges become thicker in places with the formation of suberous tissue.

The branches are frail, green or tinged with brown, and covered by a fine pubescence. The buds are arranged in two rows. The brown bud is small (7.5 mm or less), overlapping and pressed against the stem. It is downy, ovate and sharply pointed.

The alternate leaves are 2 to 4 cm long. They are thin, deciduous, simple, rounded or cordate at the base and short-stalked. The upper surface is deep bluish-green, rough or smooth, and the leaves are paler and pubescent underneath. The lateral veins form an acute angle with the midvein. The margin is coarsely toothed, except at the base. The dense foliage turns yellow in the fall.

The small greenish flowers appear at the same time as the leaves. This species is monoecious: the male flowers occur in small clusters at the base of new shoots, and the female flowers, in clusters of one to three, at the leaf axil.

The fruits are edible drupes, purple or almost black when ripe. They are 1 cm in diameter, are borne on long peduncles and remain on the tree all winter.

The root system is deep.

ORIGIN AND DISTRIBUTION

This indigenous tree was identified in 1656. It ranges from the Appalachians to the Rocky Mountains and covers southeastern Canada, especially the Great Lakes-St. Lawrence Forest Region, as well as the south shore of Lake Manitoba. In the United States, its range extends as far as southern North Carolina, Alabama and Oklahoma.

Its name comes from a Greek word which means "tree with sweet fruit".

USE

Ornamental: It provides light shade and can be used alone or as a street tree. The deep root system does not damage roads and sidewalks. When transplanted, resumption of growth is better with root ball specimens.

Ornithology: The fruits attract birds.

REQUIREMENTS

The common hackberry prefers deep, moist soils but adapts to various soil types, alkaline or acidic, moist or dry. It tolerates drought and urban pollution, and prefers a sunny exposure. It tolerates severe frosts poorly, particularly when young. It grows quickly in the initial years and requires high humidity.

PATHOLOGY

This species presents few problems of disease or insects. Occasionally, the branches are attacked by a parasitic fungus, which deforms the buds and causes an abnormal proliferation of the twigs called "witch's broom." This disease attacks only part of the tree, and the affected branch must be removed.

PROPAGATION

Seedlings: The fruits are harvested manually from the tree when they turn dark blue or black, but they can be gathered on the ground. The harvesting period can extend from leaf fall until winter. The seeds can either be conserved in the dried fruits or extracted, cleaned and dried. The fruits harvested in late fall or in the winter do not need additional drying before storage. They must be stored at 4°C in sealed containers and can remain viable for up to five years. The pulp can be removed by crushing the fruits in water. After extraction, the seeds

can be placed in moist sand for a period of 12 to 16 months, without loss of viability.

Sown outside in the fall, the seeds germinate the following spring. After storage, the seeds must be stratified for 60 to 90 days in moist sand.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Carter Seeds, United States

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

Propagation technique: The seeds were sown in a frame on November 2, 1983. They germinated in May 1984 and the seedlings were cultivated in a frame. On May 3, 1985, they were puddled, wrapped and placed in a cold store at 5°C until they were shipped a few days later.

Inclusion in test network: Young seedlings 25 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Very severe damage occurred at every site, with the percentage being higher in regions 2 and 3.

Mortality was higher in region 3.

Region 1

At L'Assomption on sand, all the seedlings were severely damaged the last two winters, while at the site on clay, the seedlings suffered only mild frost damage on the stem tips four winters out of five.

All the seedlings at Sainte-Clotilde were affected by frost damage on the entire previous year's shoot during the first two winters and the last winter. The fourth winter, damage was more severe, affecting the seedlings down to the level of snow cover and killing one of them.

At Sainte-Anne-de-Bellevue, damage was more severe the last three winters, particularly following the winter of

1987-1988, during which 100% of the seedlings suffered frost damage down to the level of snow cover.

Region 2

At Sainte-Foy, the seedlings suffered mild frost damage the first two winters, but were affected by frost damage on the entire previous year's stem the third and fourth winters, and by frost damage down to the level of snow cover the last winter.

At Deschambault, the number of seedlings affected by frost damage was slightly lower, and most of the damage occurred the last two winters, affecting virtually all of the seedlings on the entire previous year's stem.

At La Pocatière, all the seedlings in the first replication died following the second winter. In addition, frost damage down to the level of snow cover and down to the ground surface occurred the last four winters. Mortality was 40% in 1987 and 15% in 1989.

Region 3

All the seedlings at the Normandin site died during testing, most following the third and fourth winters.

At Kapuskasing, very few seedlings survived planting and most of these died during the course of testing.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.01 m R2 = 1.81 m* R3 = 0.33 m**

* The average excludes the seedlings at La Pocatière.

** This average includes only the two seedlings that survived at Kapuskasing.

Categories

The average height of the trees after five years varied from one site to another:

2.01 m and +: Sainte-Anne-de-Bellevue and L'Assomption on clay
 1.51 - 2.00 m: Sainte-Foy, L'Assomption on sand, Sainte-Clotilde and Deschambault
 1.01 - 1.50 m: -
 0.51 - 1.00 m: -
 0.50 m and -: La Pocatière and Kapuskasing

***Celtis occidentalis* L.**

Effect of pruning

Pruning was very severe because of the damage caused by frost down to the level of snow cover and down to the ground surface.

Growth in width

After five years, the average trunk diameter for each region was:

R1 = 38.6 mm R2 = 33.0 mm*
R3 = 12.5 mm**

* This average excludes the La Pocatière site.

** This average includes only the two seedlings that survived at Kapuskasing.

Categories

The average diameter of the trees after five years varied from one site to another:

46 mm and +: Sainte-Clotilde
36 - 45 mm : Sainte-Anne-de-Bellevue,
 Sainte-Foy and L'Assomption on sand
21 - 35 mm : L'Assomption on clay and
 Deschambault
16 - 20 mm : La Pocatière
11 - 15 mm : Kapuskasing

RECOMMENDATIONS

Production

Seedlings from this American provenance cannot be produced in Quebec. A study using seedlings from more northerly provenances might yield different results.

Use

Our testing did not demonstrate the potential of this species, zoned 2b by Buckley and zoned 4 by Landry et al. In fact, the seedlings were severely affected by winter damage at all the sites zoned 2 and 4a, and the seedlings at the sites in zones 4b and 5 also suffered serious frost damage.

The lack of hardiness observed can be attributed, on the one hand, to the origin of the parent plant, and on the other, to the fact that the young seedlings of this species appear to be more susceptible to frost damage.

BIBLIOGRAPHICAL REFERENCES

2, 3, 12, 13, 21, 27, 47, 50, 51, 56, 57, 60, 65, 71, 103

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Celtis occidentalis* from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
	1	2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	16	80						2	2	84
L'Assomption-sand	0	60	30	3	7					100
Ste-Anne-de-Bellevue	4	44	20	30					2	96
Sainte-Clotilde	0	25	60	13		2				100
REGION 2										
Deschambault	33	6	48					13		67
Sainte-Foy	0	40	40	20						100
La Pocatière	0		20	52	17	11				100
REGION 3										
Normandin	0	28	25			46		1		100
Kapuskasing ^b	20		13	35		12		20		80

- ^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 splitting |
| 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, 5 and 9 occurred for this species.

- ^b This average is based on only six seedlings instead of 21.

Clematis virginiana L.

See colour plate

Family	:	Ranunculaceae
English name	:	Virgin's bower
French name	:	Clématite de Virginie, herbe aux gueux
Category	:	Deciduous plant
Subdivision	:	Climbing or creeping plant

BOTANICAL DESCRIPTION

This climbing shrub can attain a height of 3 to 6 m. The glossy light green leaves are trifoliolate, broadly ovate and can occasionally have five leaflets. They are 5 to 9 cm long. The petioles almost all twist around available supports to become persistent, lignified tendrils.

Summer flowering is composed of panicles of white flowers which bloom from July to September. The flowers are approximately 16 to 20 mm across.

The fruits, achenes with a feathery aigret, are decorative in the fall.

ORIGIN AND DISTRIBUTION

This indigenous species ranges from Nova Scotia to Manitoba, southern Georgia and Kansas. It has been cultivated since 1720.

USE

Ornamental: This plant is notable for its masses of white flowers and for its fruits with feathery aigrets in the fall. It requires support to climb.

Naturalization: This species is often used for naturalization purposes.

REQUIREMENTS

This fast-growing plant is very resistant and adapts to various soil conditions. However, it does require some humidity. It can sometimes be damaged by cold, but it regenerates quite well.

PATHOLOGY

To our knowledge, no particular disease affects this species.

PROPAGATION

This plant naturally propagates by layering.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 564 cuttings were taken on July 28, 1983 and treated with a solution of 4,000 ppm IBA after soaking the foliage in a mixture of Captan and Benomyl. They were placed in a mist propagator on a substrate composed of peat and perlite (2:3). The rooting rate was 97% after four weeks. On August 23, the plants were placed in a frame. They overwintered in an open frame under a thick cover of snow and only 40% survived. They were cultivated in the nursery until May 1985.

Inclusion in test network: Young plants 12 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Most of the plants suffered winter damage at all the sites. Damage was less frequent at Sainte-Clotilde. Only one plant died at Deschambault following the first winter.

Region 1

At the two L'Assomption sites and at the Sainte-Anne-de-Bellevue site, damage was generally limited to frost damage on the stem tips. However, following the fourth winter at the L'Assomption site on clay, all the plants suffered frost damage down to the level of snow cover. At Sainte-Anne-de-Bellevue, damage was caused by rodents after the first winter.

At Sainte-Clotilde, no damage was observed following the first three winters. All the plants suffered frost damage down to the level of snow cover the following winter and frost damage on the entire previous year's shoot the last winter.

Region 2

At Sainte-Foy, all the plants were affected annually by frost damage on the stem tips. At Deschambault, this type of damage was observed the third and fourth winters. There was no damage the first winter and all the plants suffered frost damage on the entire stem the last winter.

At La Pocatière, every year, the plants suffered frost damage on the stem tips and frost damage on the entire previous year's shoots.

Region 3

At Normandin, the plants suffered frost damage on the entire previous year's shoot four years out of five. The third winter, damage was limited to the stem tips.

Nearly 60% of the plants at Kapuskasing suffered little or no damage following the first two winters. However, the last three winters, all the plants were affected by frost damage down to the level of snow cover or down to the ground surface.

Growth in height

Since the plants were cut back differently at the various sites depending on winter conditions and growing practices, there is no justification for calculating an average final height. However, the best results obtained at each site during testing are presented in the following section.

Categories

The following are the maximum heights of the plants obtained after a certain number of years.

- 3.51 - 4.00 m: Sainte-Anne-de-Bellevue (4 years)
- 3.01 - 3.50 m: Sainte-Clotilde (2 years)
- 2.51 - 3.00 m: Deschambault (3 years), L'Assomption on clay (3 years), Sainte-Foy (3 years), Normandin (3 years) and Kapuskasing (4 years)
- 2.01 - 2.50 m: L'Assomption on sand (2 years)
- 1.51 - 2.00 m: La Pocatière (2 years)

Effect of pruning

Frost damage was the main reason for the pruning carried out.

Growth in width

The measured width varied depending on the growth of the plant but also depending on the type of trellis used to train it. The results obtained therefore do not truly reflect the potential maximum width of the shrubs. At Kapuskasing, the width of the plants decreased steadily year after year.

Flowering

Flowering began between June 29 and July 7 at the Sainte-Clotilde and Sainte-Anne-de-Bellevue sites, while it was observed between July 17 and 25 at L'Assomption. The flowering period lasted from 40 to 70 days depending on the year and the plants; the peak flowering period lasted from 25 to 40 days. Mid-flowering occurred 10 to 15 days after the appearance of the first flowers.

In the Quebec City region, flowering began between July 8 and August 4 and lasted from 40 to 50 days depending on the site.

At the sites in region 3, the first flowers were observed around August 5 and the flowering period ended around mid-September.

This species flowered every year at all the sites.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year.

Production

As early as the second growing season, 70% to 100% of the plants at the sites in region 1 had attained a height of 2 to 3 m, while 40% to 70% of the plants at the La Pocatière, Normandin and Sainte-Foy sites had reached a comparable height.

A third year was necessary at Deschambault, and a fourth at Kapuskasing.

***Clematis virginiana* L.**

This is a very fast-growing species and produced stems more than 1.50 m high the first year at all the sites in region 1 as well as at Sainte-Foy. At Deschambault, La Pocatière and Normandin, this same growth was evident after the second year, since an additional year was necessary for its establishment.

This species can be produced everywhere except at Kapuskasing. It grows more quickly and is more competitive in locations comparable to the sites in region 1 and Sainte-Foy.

Use

Only one plant died during testing. Winter conditions severely affected the above-ground portion of the plants on several occasions but did not adversely affect the survival of this species. Furthermore, seasonal growth was very significant, the plants flowered abundantly and formed a large number of fruit bodies.

The test results demonstrate that this species can be used as far north as zone 2a without special protection. However, the annual growth is greater at sites where the climatic conditions are warmer.

BIBLIOGRAPHICAL REFERENCES

3, 27, 57, 60, 65, 69

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Clematis virginiana* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	20	60		20						80	
L'Assomption-sand	2	98								98	
Ste-Anne-de-Bellevue	6	80							14	94	
Sainte-Clotilde	60		20	20						40	
REGION 2											
Deschambault	24	50	25			1				76	
Sainte-Foy	0	100								100	
La Pocatière	0	52	48							100	
REGION 3											
Normandin	0	20	80							100	
Kapuskasing	12	13	6	41	28					88	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 5, 9 and 10 occurred for this species.

Table 2: Breakdown of *Clematis virginiana* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-100	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
101-200	38	29	8	25	92	71	29	8	42	33	48	0	33	100	100	67	0	0	0	0					
201-300	48	52	92	58	8	29	71	50	41	59	52	29	67	0	0	28	24	0	0	0					
301-400	0	19	0	17	0	0	0	42	17	0	0	71	0	0	0	5	71	83	50	58					
401 and +	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	0	5	17	50	42					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	0	0	0	0	0	100	0	0	0	0	100	0	0	0	8	48	0	0	0	0	100	100	83	0	8
101-200	76	24	0	83	17	0	100	0	100	100	0	60	55	100	92	52	43	8	0	50	0	0	17	0	33
201-300	24	76	100	17	83	0	0	75	0	0	0	40	45	0	0	0	57	84	100	50	0	0	0	100	59
301-400	-	-	-	-	-	0	0	25	0	0	-	-	-	-	-	0	0	8	0	0	-	-	-	-	-
401 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cornus alba 'Argenteo-Marginata' (C)

The sections Botanical Description, Origin and Distribution, Requirements, Pathology, Propagation and Bibliographical References were published previously in the second series of descriptive reports (publication 02-9309).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 415 cuttings of approximately 15 cm were taken on June 28, 1984 and immersed for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan®. They were placed in a mist propagator (clock-controlled) on a substrate composed of peat and perlite (40/60, v/v). The rooting rate was 100% after 30 days. The cuttings were potted on August 26 in Fertil Pots® and placed in a frame where they overwintered under a thick cover of snow. The survival rate was 94%. At the end of April 1985, the young plants were wrapped and placed in a cold store at 4°C until they were shipped in May.

Inclusion in test network: Plants 10 to 15 cm high and 5 cm wide were planted at nine test sites distributed across Quebec and northeastern Ontario (Tables 1 and 2). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Between 90% and 100% of the plants did not suffer any damage during the five winters except at Sainte-Anne-de-Bellevue. Damage was limited to frost damage on the tips of the previous year's shoots. A few plants died at the sites in region 1.

Region 1

No damage was observed at the sites in region 1 during the five years except at Sainte-Anne-de-Bellevue, where all the plants were affected by frost damage on the tips of the previous year's stems. During the second winter, one plant died at Sainte-Clotilde and another at L'Assomption on clay. One plant also died following the fourth winter at Sainte-Anne-de-Bellevue.

Region 2

Very little damage occurred in this region. At Sainte-Foy, it was limited to frost damage on the tips of the previous year's shoots on 15% of the plants during the first winter. At Deschambault, 25% and 8% of the plants were affected by the weight of the snow the third and fourth winters.

Region 3

No damage was observed at Normandin during the five years. At Kapuskasing, damage was limited to frost damage on the shoot tips and to damage caused by rodents on 25% of the plants during the second winter. In addition, one plant suffered damage from snow the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.35 m R2 = 1.34 m R3 = 0.95 m

Categories

The average height of the shrubs after five years varied from one site to another:

1.51 - 1.75 m: Sainte-Anne-de-Bellevue and Deschambault
 1.26 - 1.50 m: Sainte-Clotilde, Sainte-Foy and L'Assomption on sand
 1.01 - 1.25 m: La Pocatière and L'Assomption on clay
 0.76 - 1.00 m: Normandin and Kapuskasing

The final height of the shrubs increased annually at all the sites except at Sainte-Clotilde and at Normandin, where the height of the shrubs after four years was greater than the final height, and at Sainte-Foy, where it remained constant the last three years.

Effect of pruning

Pruning, done every year, eliminated on average 50% of the previous year's shoot except at La Pocatière, where virtually no pruning was done.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.32 m R2 = 1.28 m R3 = 1.08 m

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.51 - 1.75 m: Sainte-Clotilde
- 1.26 - 1.50 m: Sainte-Anne-de-Bellevue, Sainte-Foy, Deschambault, L'Assomption on sand and Kapuskasing
- 1.01 - 1.25 m: L'Assomption on clay and Normandin

The maximum width was generally attained after the third or fourth year. Thereafter, at certain sites, space constraints limited this growth (results of the best year presented).

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

During the second year, almost all the plants at the L'Assomption (on sand and on clay), Sainte-Anne-de-Bellevue, Sainte-Clotilde, La Pocatière and Normandin sites attained a height of more than 60 cm, while those at Deschambault and Sainte-Foy grew to more than 1 m. However, it took the plants at Kapuskasing three years to reach a height greater than 60 cm.

This is a relatively fast-growing cultivar since the plants attained more than half their optimal height in less than three years of growth. Its annual growth was higher

after severe pruning. The annual final height was statistically lower at the sites on clay soil.

Use

The testing demonstrated that the zoning of this cultivar established by Sherk and Buckley (zone 2) can be identified more precisely as 2a since the plants exhibited very little damage at the sites in zone 2. This behaviour suggests that this cultivar could quite probably be used almost as far north as zone 1b, taking into account the fact that the plants may occasionally suffer frost damage on the tips of the previous year's shoots in all the regions.

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Cornus alba* 'Argenteo-Marginata' from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	99					1				1	
L'Assomption-sand	100									0	
Ste-Anne-de-Bellevue	0	98					2			100	
Sainte-Clotilde	99					1				1	
REGION 2											
Deschambault	92							8		8	
Sainte-Foy	97	3								3	
La Pocatière	100									0	
REGION 3											
Normandin	100									0	
Kapuskasing	88	5						2	5	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 splitting |
| 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, 6, 7 and 9 occurred for this species.

Table 2: Breakdown of *Cornus alba* 'Argenteo-Marginata' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	38	10	0	0	0	90	20	0	0	0	100	0	0	0	0	68	5	0	0	0					
51-100	62	90	75	25	8	10	80	100	100	58	0	95	0	0	0	32	84	0	0	0					
101-150	0	0	25	75	92	0	0	0	0	42	0	5	100	33	67	0	11	100	75	17					
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	67	33	0	0	0	25	83					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	14	0	0	0	0	76	0	0	0	0	100	19	0	0	0	72	33	0	0	0	100	100	17	0	0
51-100	86	62	0	0	0	24	71	8	0	0	0	81	92	42	42	28	67	42	33	66	0	0	83	100	75
101-150	0	38	100	100	100	0	29	92	83	17	0	0	8	58	58	0	0	58	67	34	0	0	0	0	25
151-200	-	-	-	-	-	0	0	0	17	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cornus alba 'Argenteo-Marginata' (C)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the second series of descriptive reports (publication 02-9309).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 389 cuttings of approximately 15 cm were taken on July 25, 1985 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator on a substrate composed of peat (40%) and perlite (60%). The rooting rate was 69% after 28 days and more than 90% of the unrooted cuttings formed roots in September. The plants were potted on August 22 and 31 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame in early September. The plants overwintered in the frame under a thick cover of snow. In May 1986, the plants were wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 15 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

One or two plants died at each of the sites in region 1 during the first two winters.

At the l'Assomption site on sand, 33% of the plants suffered frost damage on the stem tips during the first winter and only one plant suffered damage the following winter.

At the l'Assomption site on clay and the Sainte-Clotilde site, no damage occurred.

Region 2

At Sainte-Foy, between 20% and 33% of the plants exhibited signs of frost damage on the stem tips during the first and third winters.

At Deschambault, 17% of the plants suffered mechanical breakage the third and fifth winters.

At La Pocatière, all the plants were affected by frost damage on the stem tips the first winter only.

Region 3

At Normandin, no frost damage occurred and, at Kapuskasing, only one plant showed signs of frost damage on the stem tips the first winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.40 m R2 = 1.26 m R3 = 1.16 m

There is a growth gradient between the plants in regions 1 to 3.

The plants at the L'Assomption site on clay brought down the regional average.

Categories

The average height of the shrubs after five years varied from one station to another:

- 1.51 m and + : Sainte-Clotilde, Deschambault and L'Assomption on sand
- 1.26 - 1.50 m: Normandin
- 1.01 - 1.25 m: Sainte-Foy and La Pocatière
- 1.00 m and - : L'Assomption on clay and Kapuskasing

Effect of pruning

The pruning carried out every spring eliminated on average 50% of the previous year's shoot except at La Pocatière, where virtually no pruning was done.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.40 m R2 = 1.38 m R3 = 1.48 m

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.51 m and + : L'Assomption on sand, Deschambault and Normandin
- 1.26 - 1.50 m: Sainte-Foy, Kapuskasing, Sainte-Clotilde and La Pocatière
- 1.25 m and - : L'Assomption on clay

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

At all the sites, except at La Pocatière, where the pedological conditions were not very favourable, 80% or more of the plants had attained a height of 51 to 100 cm after two years of growth.

This is a relatively fast-growing cultivar since the plants attained more than half their optimal height in four years of growth, including the year following propagation. Its annual growth was higher after severe pruning. In addition, it seems to grow more slowly on clay soils.

Use

The testing demonstrated that the zoning of this cultivar established by Sherk and Buckley (zone 2) is relatively conservative since the plants exhibited very little damage at the sites in zone 2. We can recommend the use of this plant throughout Quebec, taking into account the fact that the plants may occasionally suffer frost damage on the tips of the year's shoots in all the regions.

WRITTEN BY

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Table 1: Frequency of winter damage observed on *Cornus alba* 'Argenteo-Marginata' from 1986 to 1991

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	98					2					2
L'Assomption-sand	90	8				2					10
Sainte-Clotilde	99					1					1
REGION 2											
Deschambault	92							8			8
Sainte-Foy	89	11									11
La Pocatière	81	19									19
REGION 3											
Normandin	100										0
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 splitting |
| 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 types 4, 5, 6, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Cornus alba* 'Argenteo-Marginata' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	90	11	8	0	0	62	16	0	0	0	71	0	0	0	0										
51-100	10	89	42	0	0	38	84	100	100	67	29	95	8	0	0										
101-150	0	0	50	91	42	0	0	0	0	33	0	5	82	100	25										
151-200	0	0	0	9	58	-	-	-	-	-	0	0	0	0	75										
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	67	0	0	0	0	48	5	0	0	0	100	43	0	0	0	33	0	0	0	0	100	19	0	8	0
51-100	33	95	17	75	17	52	95	50	0	0	0	57	100	100	58	67	5	8	58	0	0	81	100	92	67
101-150	0	5	83	25	83	0	0	50	58	42	0	0	0	0	42	0	95	92	42	100	0	0	0	0	33
151-200	-	-	-	-	-	0	0	0	42	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Cornus alba* 'Argenteo-Marginata' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	5	0	0	0	90	26	0	0	0	100	0	0	0	0
51-100	0	85	33	0	8	10	74	92	42	42	0	67	0	0	0
101-150	0	10	67	82	34	0	0	8	58	58	0	33	42	92	75
151-200	0	0	0	18	58	-	-	-	-	-	0	0	58	8	25

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	95	5	0	0	0	100	10	0	0	0	100	72	0	0	0	100	0	0	0	0	100	38	0	0	0
51-100	5	61	17	42	0	0	80	42	33	0	0	28	83	58	0	0	0	0	58	0	0	62	100	8	0
101-150	0	34	83	58	50	0	10	58	67	50	0	0	17	42	100	0	95	92	42	67	0	0	0	84	83
151-200	0	0	0	0	50	0	0	0	0	50	-	-	-	-	-	0	5	8	0	33	0	0	0	8	17

Cornus alba 'Spaethii'

See colour plate

Family	:	Cornaceae
English name	:	Golden dogwood
French name	:	Cornouiller de Spaeth
Category	:	Deciduous plant
Subdivision	:	Shrub

of the bark is more vivid on the young stems and on shrubs exposed to full sunlight. Regular pruning for rejuvenation promotes the development of new stems.

PATHOLOGY

This species can be heavily infested by scale insects and, occasionally, by aphids.

PROPAGATION

Propagation by cuttings: Propagation is carried out using softwood cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: City of Montreal Park, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: Cuttings of 18 cm were taken on July 9, 1985 and immersed in a solution of 4,000 ppm IBA and 50% ethanol. They were placed in a substrate of perlite (100%) and mist was applied for an average duration of 30 seconds every seven minutes. The rooting rate was 85% after four weeks. The cuttings were potted on August 6 in Fertile Pots[®] in a substrate composed of Pro-Mix[®] (50%), compost (25%) and sand (25%) and cultivated in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Plants 15 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the l'Assomption site on sand, 15% of the plants died during the second winter and one plant showed signs of frost damage on the stem tips during the first winter. No other damage occurred during testing. At the site on clay, the behaviour was very similar, apart from the fact that only 5% of the plants died during the first winter.

BOTANICAL DESCRIPTION

This bushy shrub can attain a height and width of 2 m. The stems are upright and the bark of the young stems is bright red.

The leaves are opposite, oval, entire, sharp-tipped and slightly hairy on both sides. They are 8 to 10 cm long. They are green and bronze-coloured when young, and become coarsely mottled and tinged with yellow when mature. The foliage keeps its colour all summer and does not fade in the sun.

The small yellowish flowers appear in flattened cymes in June. The second flowering in August is relatively insignificant.

The fruits, pisiform drupes, are white or bluish.

ORIGIN AND DISTRIBUTION

This cultivar was developed in Berlin in 1885 by Mr. Spaeth.

USE

Ornamental: This cultivar can be used alone or in groups for the colour of its foliage and branches. Its growth is less vigorous than that of *Cornus alba* 'Argenteo-Marginata'. It tolerates severe pruning well.

REQUIREMENTS

This cultivar adapts well to several types of soil but the colour of the foliage is better when the soil is not too rich. It must be sufficiently moist and slightly acidic. The colour of the foliage fades in the shade. The colour

At the Sainte-Clotilde site, 17% of the plants died during the fourth winter; these plants had shown little or no growth the previous year. No other damage was observed at this site.

Region 2

At Sainte-Foy, one plant died the first winter.

At Deschambault, the mortality rate was 13%, with the plants dying during the first and fourth winters. In addition, at this site, mechanical breakage caused by the weight of the snow damaged 42% and 56% of the plants the last two winters.

At La Pocatière, no plants died. However, all the plants were affected by frost damage the first winter: 85% by frost damage on the stem tips and 15% by frost damage on the previous year's shoot. In addition, one other plant showed signs of frost damage during the third winter. In general, the plants fared quite well during the last four winters.

Region 3

No frost damage and no mortality occurred at Normandin.

At Kapuskasing, one plant exhibited frost damage on the old wood the first winter and 27% of the plants suffered damage caused by sunscald and mechanical breakage during the last two winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.48 m R2 = 1.18 m R3 = 1.05 m

The plants at the La Pocatière and L'Assomption on clay sites brought down their respective regional averages.

Categories

The average height of the shrubs after five years varied from one station to another:

1.26 - 1.50 m: L'Assomption on sand, Sainte-Clotilde and Deschambault

1.01 - 1.25 m: Normandin, Sainte-Foy and La Pocatière
1.00 m and -: Kapuskasing and L'Assomption on clay

Effect of pruning

Pruning caused a reduction in the previous year's shoots of approximately 30% to 50% the first two years.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.18 m R2 = 1.53 m R3 = 1.47 m

The plants were also as wide as they were high in region 1 and wider in regions 2 and 3.

Categories

The average width of the shrubs after five years varied from one station to another:

1.51 m and + : Sainte-Foy and Normandin
1.26 - 1.50 m : Deschambault, L'Assomption on sand, La Pocatière, Sainte-Clotilde and Kapuskasing
1.01 - 1.25 m : -
1.00 m and - : L'Assomption on clay

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The rate of production of this cultivar was very similar from one region to another. Indeed, after two years of growth, all the plants at Sainte-Clotilde, Sainte-Foy, Deschambault and Normandin had attained a height of between 51 and 100 cm. At the sites on clay soil, growth was slower.

Cornus alba* 'Spaethii'*Use**

Sherk and Buckley assign a zone rating of 2 to the various cultivars of *Cornus alba*. Indeed, the test results show very little damage in zone 2a and it is probable that this plant can be used as far north as zone 1b. Although it grew more slowly in cold regions, the growth habit of the plant remained very interesting and the colour of the foliage quite constant.

BIBLIOGRAPHICAL REFERENCES

4, 10, 12, 23, 45, 49, 50, 51, 52, 60, 70, 85, 86, 101, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Cornus alba* 'Spaethii' from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage								Cumulative damage	
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	98	1				1					2
L'Assomption-sand	96	1					3				4
Sainte-Clotilde	97						3				3
REGION 2											
Deschambault	72					2		26			28
Sainte-Foy	99					1					1
La Pocatière	78	19	3								22
REGION 3											
Normandin	100										0
Kapuskasing	88							5	7		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 splitting
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 types 3, 6, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Cornus alba* 'Spaethii' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	95	47	10	0	0	100	89	50	33	8	95	0	0	0	0										
51-100	5	53	90	30	10	0	11	50	67	92	5	100	75	50	0										
101-150	0	0	0	70	70	-	-	-	-	-	0	0	25	50	100										
151 and +	0	0	0	0	20	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	67	0	0	0	0	80	0	0	0	0	100	70	8	25	0	67	5	0	0	0	100	78	36	0	0
51-100	33	100	67	75	17	15	90	92	8	0	0	30	92	75	33	33	47	75	83	0	0	22	64	100	100
101-150	0	0	33	25	83	5	10	8	92	92	0	0	0	0	67	0	48	25	17	100	-	-	-	-	-
151 and +	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Cornus alba* 'Spaethii' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	95	26	0	0	0	85	26	16	25	16	100	0	0	8	0
51-100	5	64	10	10	0	15	74	84	75	66	0	65	25	33	0
101-150	0	10	90	80	40	0	0	0	0	18	0	35	42	50	90
151-200	0	0	0	10	60	-	-	-	-	-	0	0	33	9	10

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	80	0	0	0	0	100	0	0	0	0	100	75	0	0	0	95	0	0	0	0	100	56	0	0	0
51-100	20	25	0	0	0	0	100	42	16	0	0	25	58	25	16	5	0	0	33	0	0	44	91	9	0
101-150	0	75	83	100	25	0	0	42	84	59	0	0	42	75	50	0	76	92	67	33	0	0	9	81	100
151-200	0	0	17	0	75	0	0	16	0	41	0	0	0	0	34	0	24	8	0	67	0	0	0	10	0

Cornus alternifolia L.f.

See colour plate

Family	:	Cornacea
English name	:	Pagoda or alternate-leaved dogwood
French name	:	Cornouiller à feuilles alternes
Synonym	:	<i>Swida alternifolia</i> (L. f.) Small
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This small tree can attain a height of 5 to 10 m when cultivated as a single-stemmed tree. When grown as a shrub, it can attain a height of 4 to 6 m and a width of 5 to 8 m. It has a wide, spreading growth habit.

The horizontal branches grow in tiers and are of unequal lengths. Their alternate position is one of the features which distinguishes this species from other dogwoods. The colour of the shiny young stems ranges from reddish-green to purplish.

The trunk is short. The bark is thin, reddish-brown and smooth on young trees, separating into inconspicuous ridges with age.

The leaf buds are small, pointed, with two or three brownish-red scales; the exterior scales are not closely set against the internal parts of the bud.

The leaves are dark green above and dull green or whitish beneath. The leaves are alternate and crowded at the stem tips. The petioles, which are more than 6 cm long at the base of the new shoot, become increasingly shorter as they near the shoot tip, thereby giving the leaves the appearance of being whorled around the shoot. The leaves are 4 to 13 cm long and 2.0 to 7.5 cm wide. The blade is ovate, the tip is acuminate, the base is rounded and narrow, and the margin is entire and wavy.

The flower buds are purplish, glabrous at the base and pubescent at the tip. The small, creamy white flowers are numerous, pubescent and arranged in open, irregularly rounded cymes flattened at the top. They appear in late spring, with each flower being borne on a jointed stalk.

The fruits, drupes, are initially green, turning blackish-blue when ripe. They are approximately 6 mm in diameter and are borne on red peduncles.

ORIGIN AND DISTRIBUTION

This indigenous species is common in the Great Lakes-St. Lawrence Deciduous Forest Region and in the Acadian Forest Region. In Quebec, it can be found in maple stands. It is not found in the Lac Saint-Jean, Saguenay Valley and Anticosti Island zones.

In Ontario, it is less common to the north and east of Lake Superior. Its natural northern limit appears to be the 49th parallel. In the United States, it is found from Minnesota to Alabama.

This species was named around 1760.

USE

Ornamental: This species is very interesting for its unusual open Y-shaped growth habit. Its dimensions make it suitable for small gardens. Its flowers and fruit are also interesting ornamental features.

Wood use: The light-coloured wood has no commercial value. It is heavy, hard, uniform in structure, resistant to abrasion and becomes smooth when rubbed.

REQUIREMENTS

This species prefers deep, well-drained soils. It grows along with other species in uncrowded stands, along rivers and streams, bordering on swamps and at the bottom of steep slopes.

Its growth is slow on planting but subsequently increases.

PATHOLOGY

This species is very resistant to anthracnose, which affects dogwoods.

PROPAGATION

Seedlings: The seeds mature inside the fruits during the fall. The cleaned seeds require stratification for five months at room temperature, followed by stratification for three months at 5°C.

Propagation by cuttings: Softwood cuttings root well when treated with a solution of 8,000 ppm IBA. They must not be disturbed during the propagation period until new shoots form; this can be induced by providing additional light.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Naturally growing specimen, St-Sauveur, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were harvested in September 1982. They were sown immediately in flats and over-wintered in a frame. They germinated in the spring of 1983. The seedlings were potted in the spring of 1985 in Fertil Pots® in a substrate composed of compost (50%), sand (25%) and peat (25%). They were placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young seedlings 15 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the l'Assomption site on sand, all the seedlings suffered damage on the stems tips the first winter only. No damage occurred on the seedlings at the L'Assomption site on clay.

At Sainte-Clotilde, three seedlings died: two during the first winter and another the last winter. These seedlings had shown very good growth previously.

Region 2

Depending on the year, the seedlings at Sainte-Foy did not suffer any damage or frost damage on the stem tips. One seedling died during the second winter and another during the third winter.

At Deschambault, 52%, 17%, 33% and 25% of the seedlings suffered mechanical breakage, caused by the weight of the snow, the last four winters.

At La Pocatière, all the seedlings in replications 1 and 2 and a portion of those in the third replication died during the first winter; this mortality was due to poor pedological conditions. The two seedlings that survived establishment exhibited no damage during testing.

Region 3

No frost damage was observed at Normandin.

At Kapuskasing, 38% of the seedlings suffered slight damage on the stem tips and one seedling died the first winter. In addition, 33% of the seedlings suffered frost damage down to the level of snow cover the fourth winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.11 m R2 = 1.77 m R3 = 1.28 m

The final height of the seedlings was higher in region 1.

Growth on clay soils was less favourable in all three regions.

Categories

The average height of the trees after five years varied from one station to another:

2.01 - 2.50 m: L'Assomption on sand, Sainte-Clotilde and Deschambault
 1.51 - 2.00 m: Sainte-Foy and L'Assomption on clay
 1.00 - 1.50 m: Normandin, La Pocatière and Kapuskasing

Effect of pruning

At some sites, pruning was done to facilitate access to the plots by cultivation equipment.

Cornus alternifolia Lf.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 1.53 m R2 = 1.54 m R3 = 1.18 m

The width of the seedlings at Sainte-Clotilde reflects only the growth of the first three years. The seedlings were pruned thereafter to facilitate cultivation operations. The maximum width after five years is therefore unknown.

In region 1, the seedlings were clearly higher than they were wide. In region 2, they were slightly higher and in region 3, the height and width were essentially the same.

Categories

The average width of the trees after five years varied little from one station to another:

1.51 - 2.00 m: L'Assomption on sand, Sainte-Foy, Deschambault and Sainte-Clotilde
 1.00 - 1.50 m: Normandin, L'Assomption on clay, La Pocatière and Kapuskasing

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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This species exhibited very little growth the first year at all the sites. In general, annual growth was very significant the second, third and sometimes fourth year. It was nil or almost nil thereafter.

Use

According to Sherk and Buckley, the zone rating for this species is 3b. The results of our testing demonstrated its hardiness as far north as zone 2a. However, since the seedlings did not exceed a height of 1.00 m and 1.50 m, the stem tips above the snow cover during the last winters were not exposed to the harsher winter conditions of zones 2b and 2a. It seems reasonable not to change the previously assigned zoning even though this species seems to have a higher adaptation potential. It may be worthwhile to continue testing on this species. The growth of this species was slower on clay soils.

BIBLIOGRAPHICAL REFERENCES

4, 8, 12, 27, 49, 50, 51, 56, 57, 65, 83, 86, 95

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Cornus alternifolia* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	3	4	6	7	8	5 and 9	10	11	14	
REGION 1												
L'Assomption-clay	100											0
L'Assomption-sand	80	20										20
Sainte-Clotilde	96						4					4
REGION 2												
Deschambault	64							4	32			36
Sainte-Foy	65	31					3			1		35
La Pocatière ^b	81			1			18					19
REGION 3												
Normandin	100											0
Kapuskasing	81	8	2		7		1	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 splitting |
| 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 types 7, 9 and 14 occurred for this species.

^b 95% of the seedlings at La Pocatière died during the first winter. This mortality is due to poor pedological conditions.

Table 2: Breakdown of *Cornus alternifolia* seedlings by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-50	100	0	0	0	0	76	0	0	0	0	95	0	0	0	0															
51-100	0	90	0	0	0	24	90	8	0	0	5	5	0	0	0															
101-150	0	10	67	0	0	0	10	92	100	17	0	95	8	0	0															
151-200	0	0	33	58	8	0	0	0	0	83	0	0	83	58	17															
201-250	0	0	0	33	67	-	-	-	-	-	0	0	9	42	67															
251-300	0	0	0	9	25	-	-	-	-	-	0	0	0	0	16															
Height (cm)	REGION 2										REGION 3																			
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	95	0	0	0	0	100	100	0	0	0	95	0	0	0	0	100	50	0	0	0	0	0	0	0	0
51-100	0	75	8	0	0	5	76	0	0	0	0	0	100	50	50	5	95	17	0	0	0	50	100	42	33					
101-150	0	25	75	27	0	0	24	58	0	0	0	0	0	50	50	0	5	83	83	67	0	0	0	58	67					
151-200	0	0	17	73	91	0	0	42	25	25	-	-	-	-	-	0	0	0	17	33	-	-	-	-	-	-	-	-	-	-
201-250	0	0	0	0	9	0	0	0	75	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Cornus alternifolia* seedlings by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	100	5	0	0	0	100	0	0	0	0
51-100	0	71	8	0	0	0	95	100	58	17	0	100	0	0	0
101-150	0	29	83	42	17	0	0	0	42	75	0	0	50	75	92
151-200	0	0	9	58	67	0	0	0	0	8	0	0	50	25	8
201-250	0	0	0	0	16	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	100	0	0	0	0	100	100	50	0	0	100	19	0	0	0	100	85	8	0	8
51-100	0	75	17	0	0	0	100	17	0	8	0	0	50	50	50	0	81	33	25	0	0	15	92	75	17
101-150	0	25	83	82	0	0	0	75	100	17	0	0	0	50	50	0	0	67	75	100	0	0	0	25	75
151-200	0	0	0	18	91	0	0	8	0	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201-250	0	0	0	0	9	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cornus sanguinea L.

See colour plate

Family	:	Cornaceae
English name	:	Bloodtwig dogwood
French name	:	Cornouiller sanguin
Category	:	Deciduous plant
Subdivision	:	Shrub

USE

Ornamental: This species is very interesting for the colour of its branches during the winter and for the colour of its fall foliage. It is also used to fill in the base of large windbreaks since it tolerates the competition of large trees. It is used in large open spaces.

It sends out suckers easily.

Wood use: The wood is hard and strong.

REQUIREMENTS

This species adapts to all soil types, even sandy ones, but prefers rich, deep soils and those with a slightly calcareous pH. It is less tolerant of acidic soils and drought.

Its growth is very rapid when the plant is young and becomes moderate to slow when the plant is older.

This species is easily transplanted and requires frequent pruning for rejuvenation in order to maintain the colour of the stems. It tolerates semi-sunny or shady exposures, but the colour of the stems is more vivid in sunny locations.

PATHOLOGY

No serious disease seems to attack this species.

PROPAGATION

Seedlings: The seeds reach maturity in the fall. The cleaned seeds require five months of stratification at room temperature followed by three months of stratification at 5°C.

Propagation by cuttings: According to certain reference sources, cuttings taken at the beginning of summer have achieved a rooting rate of 44% without hormone treatment and of 68% following treatment with IBA (30 ppm), within three weeks.

PROPAGATION CARRIED OUT BY REPLOQ

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

Propagation site: Montreal Botanical Garden, Montreal, Quebec

BOTANICAL DESCRIPTION

This shrub with an upright growth habit can reach a height of 4 to 5 m in Europe. The branches are downy, greenish when they begin to form and later turn blood red. The lower surface is often more greenish. There is significant variation in the colour of the stems and the growth habit of the plants.

The foliage is dark green with purplish shades during the summer season, turning red in the fall. The leaves are opposite, simple, elliptic to ovate, acuminate and rounded at the base. They are pubescent on both sides and are 4 to 10 cm long and 4 to 5 cm wide. They have three to five pairs of conspicuous veins. The petiole is 6 to 15 mm long.

The flower bud is covered with greyish, pubescent scales. The small, creamy white flowers are numerous and take the form of dense, hairy cymes 4 to 5 cm wide. They appear in late spring but are quite hidden because of the abundant foliage. They have a strong or fetid odour.

The fruits, drupes, become bright blackish purple with white spots when ripe. They are approximately 6 mm in diameter and are borne on red peduncles.

ORIGIN AND DISTRIBUTION

This European species originates in Czechoslovakia and Romania. It is abundant on limestone soils, along the banks of rivers and streams and embankments. It has been cultivated for several centuries.

Propagation technique: Cuttings of 20 cm were taken on June 27, 1985 from parent plants approximately 15 years old. They were dipped for five seconds in a solution of 4,000 ppm IBA and 50% ethanol. They were placed in a substrate of perlite (100%) and mist was applied for an average duration of 30 seconds every seven minutes. The cuttings were potted on August 2 and September 3 in Fertal Pots[®] in a substrate composed of Pro-Mix[®] (50%), compost (25%) and sand (25%). The rooting rate was 70% during the first potting. They were placed in a frame until they were shipped in the spring of 1986. The winter survival rate was 90%.

Inclusion in test network: Young plants 12 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

This species suffered breakage caused by the wind at several sites. At the two sites where this damage occurred during the first two years, a few plants died as a result. In addition, this species is, in general, more frost-sensitive during the first two years of growth.

Region 1

At the L'Assomption site on sand, only 24% of the plants suffered slight frost damage on the stem tips during the first winter.

At the L'Assomption on clay and Sainte-Clotilde sites, no damage affected the plants.

Region 2

At Sainte-Foy, the behaviour was identical to that at the L'Assomption site on sand.

At Deschambault, no winter damage affected the plants; only mechanical breakage was observed following the last three winters.

At La Pocatière, 75% of the plants exhibited signs of frost damage on the stem tips following the first winter and one plant died. No other damage was observed.

Region 3

At Normandin, 37% of the plants suffered mild frost damage on the stem tips during the first winter.

At Kapuskasing, 45% of the plants suffered damage to varying degrees during the first two winters. The last two winters, the plants were damaged by mechanical breakage and splitting of the stems.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.43 m R2 = 1.67 m R3 = 1.73 m

The growth of the plants at Sainte-Foy was almost nil during the last three years, lowering the average in region 2. In general, the plants doubled in height between the first and second growing seasons.

Categories

The average height of the shrubs after five years varied from one station to another:

1.51 m and + : Sainte-Clotilde, L'Assomption on sand and Deschambault

1.01 - 1.50 m: Normandin, L'Assomption on clay and La Pocatière

1.00 m and - : Sainte-Foy and Kapuskasing

Growth on clay soils was poorer than on lighter soils.

Effect of pruning

Pruning was relatively minor except in cases where wind damage broke large lateral branches.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.67 m R2 = 1.67 m R3 = 1.73 m

The plants at the Sainte-Clotilde site had a significantly larger final width at the end of the third year of growth than at the end of the test.

<i>Cornus sanguinea</i> L.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 40, 49, 58, 95

The plants at the Normandin site had attained their maximum width after two years of growth.

Categories

The average width of the shrubs after five years varied from one station to another:

1.76 - 2.00 m: Normandin, La Pocatière, Deschambault, Sainte-Clotilde and L'Assomption on sand

1.51 - 1.75 m: Kapuskasing

1.50 m and - : Sainte-Foy and L'Assomption on clay

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

By the end of the second growing season, 70% to 100% of the plants had attained a height of between 51 cm and 100 cm at all the sites. This species grows very quickly. Once the plant has reached a significant size, it tends to be vulnerable to breakage caused by the wind.

It is therefore possible to produce this dogwood throughout Quebec.

Use

The zone rating of 4b, established by Buckley, appears to be an underestimate for this species. The test results showed that this European species is much better adapted to our climatic conditions and no serious frost damage occurred even in zone 2a. Its new zone rating is therefore 2, although slight damage can occur on young growing plants.

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Table 1: Frequency of winter damage observed on *Cornus sanguinea* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	3	4	6	7	8	5 and 9	10	11	14	
REGION 1												
L'Assomption-clay	100											0
L'Assomption-sand	95	5										5
Sainte-Clotilde	100											0
REGION 2												
Deschambault	80								20			20
Sainte-Foy	95	5										5
La Pocatière	84	15					1					16
REGION 3												
Normandin	93	7										7
Kapuskasing	69	8	7					6	10			31

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 4, 5, 6, 7, 11 and 14 occurred for this species.

Table 2: Breakdown of *Cornus sanguinea* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	62	13	0	0	0	30	5	8	0	0	82	0	0	0	0										
51-100	38	60	10	0	0	70	90	75	58	33	12	0	8	18	0										
101-150	0	27	90	80	40	0	5	17	42	67	6	100	67	54	33										
151-200	0	0	0	20	60	-	-	-	-	-	0	0	25	28	67										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	86	0	0	0	0	33	0	0	0	0	95	16	8	0	0	10	0	0	0	0	80	30	0	0	0
51-100	14	100	67	100	92	67	24	33	0	0	5	80	92	100	50	84	5	0	17	0	20	70	100	100	92
101-150	0	0	33	0	8	0	72	67	67	58	0	4	0	0	50	6	95	100	83	75	0	0	0	0	8
151-200	-	-	-	-	-	0	4	0	33	42	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-

Table 3: Breakdown of *Cornus sanguinea* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	38	7	0	0	0	30	5	0	0	0	82	0	0	0	0
51-100	62	13	0	0	0	70	30	50	8	0	18	0	8	0	8
101-150	0	80	50	40	20	0	65	50	92	92	0	82	0	18	67
151-200	0	0	50	60	60	0	0	0	0	8	0	18	67	64	25
201-250	0	0	0	0	20	-	-	-	-	-	0	0	25	9	0
251 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	9	0

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	62	0	0	0	0	76	0	0	0	0	95	0	0	0	0	32	0	0	0	0	75	5	0	0	0
51-100	38	0	0	33	0	24	67	8	0	0	5	95	0	0	0	58	0	0	0	0	25	30	8	0	8
101-150	0	76	100	67	67	0	33	92	75	8	0	5	67	42	25	10	0	8	67	8	0	55	75	33	17
151-200	0	24	0	0	33	0	0	0	25	83	0	0	33	42	42	0	89	92	33	83	0	10	17	67	67
201-250	-	-	-	-	-	0	0	0	0	9	0	0	0	16	33	0	11	0	0	9	0	0	0	0	8
251 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cornus sericea 'Flaviramea'

See colour plate

Family	:	Cornaceae
English name	:	Yellowtwig dogwood
French name	:	Cornouiller à tiges jaunes
Synonym	:	<i>Cornus stolonifera</i> 'Flaviramea'
Category	:	Deciduous plant

BOTANICAL DESCRIPTION

This large shrub, with a loose and round growth habit, can attain a height of 2.50 m.

The yellow branches are erect and new branches form continually at the base.

The foliage is dense. The leaves are opposite, simple, ovate to oblong, acuminate, rounded at the base and 5 to 12 cm long and 2 to 5 cm wide. They are light green, glaucous on the upper surface and are composed of five pairs of veins.

The flowers, in umbels, are white and appear in late spring. Flowering is not particularly impressive.

ORIGIN AND DISTRIBUTION

The species originates in the eastern United States. The 'Flaviramea' cultivar was first offered commercially by Spaeth Nursery, in Germany, around 1899 or 1900. The latter reportedly received it from the Arnold Arboretum.

USE

Ornamental: This cultivar can be used in clumps or standing alone for the distinctive colour of its branches, mainly during the winter season.

REQUIREMENTS

This cultivar, like the species, adapts to all soil types but prefers moist soils and even tolerates wet soils.

It is easily transplanted by the bare root or root ball method or when grown in a container.

PATHOLOGY

This cultivar is sometimes affected by canker.

PROPAGATION

Propagation by cuttings: This species is considered easy to propagate by cuttings and the cuttings can be taken throughout the summer.

Its natural reproduction is by stolons.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 386 cuttings of approximately 15 cm were taken on July 13, 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator on a substrate composed of peat (40%) and perlite (60%). The rooting rate was 99% after 27 days. The cuttings were potted on August 2 and 9 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 15, and growth continued during the fall. The plants over-wintered in the frame under a thick cover of snow. The winter survival rate was 88%; 256 plants were transplanted to the nursery in May 1985 and the recovery rate was 95%. They overwintered in the nursery and the winter survival rate was 100%. They were dug up on May 1, 1986, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 50 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

This cultivar is, in general, more sensitive to frost during the first two or three years, but the damage observed was light and did not affect the survival of the plants.

Region 1

At the l'Assomption site on sand, the majority of the plants suffered sunscald during the first and third winters while, at the site on clay, 33% to 38% of the plants suffered frost damage during the first three winters. In addition, at the latter site, 33% of the plants were affected by frost damage on the stem tips during the third winter. Thereafter, the plants did not suffer any other damage.

No damage was observed at Sainte-Clotilde.

Region 2

At Sainte-Foy, 67% to 100% of the plants suffered frost damage on the stem tips, one year out of two. In addition, one plant died the fourth winter. No other damage was observed on this cultivar.

At Deschambault, 33% of the plants exhibited signs of frost damage on the stem tips following the second and last winters and no other damage affected the plants.

At La Pocatière, all the young plants suffered frost damage down to the level of snow cover the first winter, but no other damage occurred subsequently.

Region 3

At Normandin, all the plants suffered frost damage on the stem tips the first and fourth winters.

At Kapuskasing, as at the L'Assomption sites, sunscald damage was observed on 86% of the plants following the first winter and frost damage was noted on the stem tips of one plant. Thereafter, the plants did not suffer any other damage.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.72 m R2 = 1.34 m R3 = 1.19 m

The longer the growing season, the greater the height of the plants at the end of the season.

Categories

The average height of the shrubs after five years varied from one station to another:

1.76 m and + : L'Assomption on sand and Sainte-Clotilde
 1.51 - 1.75 m: Deschambault
 1.26 - 1.50 m: Normandin, L'Assomption on clay and Sainte-Foy
 1.01 - 1.25 m: La Pocatière
 1.00 m and - : Kapuskasing

Annual growth was slower on heavy soils.

Effect of pruning

Pruning for shaping is necessary for this cultivar.

Growth in width

After five years, the average width for each region was:

R1 = 1.93 m R2 = 1.96 m R3 = 1.71 m

The La Pocatière site brought down the regional average. In general, in region 1, the plants were slightly wider than they were high while, in region 2, the plants were clearly wider.

Categories

The average width of the shrubs after five years varied from one station to another:

2.01 - 2.35 m: Deschambault, L'Assomption on sand and Sainte-Foy
 1.76 - 2.00 m: L'Assomption on clay and Normandin
 1.51 - 1.75 m: Sainte-Clotilde, Kapuskasing and La Pocatière

This cultivar yielded good growth at the La Pocatière site, where the pedological conditions were less favourable.

At Sainte-Foy, the plants exhibited little growth between the second and fourth growing seasons.

Cornus sericea* 'Flaviramea'*RECOMMENDATIONS**

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This dogwood is very easy to produce and exhibits strong growth regardless of the region where it is cultivated. Indeed, after two years, almost all the plants at the L'Assomption on sand, Sainte-Clotilde and Deschambault sites had attained a height greater than 1.00 m. At the other sites an additional year of growth was necessary to obtain an equivalent percentage of plants that had attained a comparable height. However, the pedological conditions at La Pocatière slowed the growth of the plants and this batch of plants is not comparable to those at the other sites.

Use

The type species was zoned 1b by Sherk and Buckley. The test results confirm the hardiness potential of the 'Flaviramea' cultivar for this zone rating since no serious damage occurred at Kapuskasing and none of the plants in zone 2a died.

This plant seems to adapt well to difficult pedological conditions (drainage) although this results in slower growth.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 49, 56, 57, 86, 102

WRITTEN BY

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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Cornus sericea* 'Flaviramea' from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	73	7					20				27
L'Assomption-sand	62						38				38
Sainte-Clotilde	100										0
REGION 2											
Deschambault	82	17						1			18
Sainte-Foy	48	50				2					52
La Pocatière	80			20							20
REGION 3											
Normandin	60	40									40
Kapuskasing	82	1					17				18

- ^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 splitting |
| 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 types 3, 4, 5, 7, 11 and 14 occurred for this species.

Table 2: Breakdown of *Cornus sericea* 'Flaviramea' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0
51-100	100	5	0	0	0	100	62	17	0	0	76	0	0	0	0
101-150	0	95	83	33	8	0	38	83	100	83	0	100	67	25	0
151-200	0	0	17	67	42	0	0	0	0	17	0	0	33	75	100
201-250	0	0	0	0	50	-	-	-	-	-	-	-	-	-	-
Height (cm)	REGION 2														
	Sainte-Foy					Deschambault					La Pocatière				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	14	0	0	0	0	48	0	0	0	0	100	38	0	0	0
51-100	86	38	0	0	0	52	14	17	0	0	0	62	100	100	33
101-150	0	62	100	100	100	0	86	83	42	33	0	0	0	0	67
151-200	-	-	-	-	-	0	0	0	58	67	-	-	-	-	-
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Height (cm)	REGION 3														
	Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90					
0-50	10	0	0	0	0	76	0	0	0	0					
51-100	90	14	0	17	0	24	100	100	100	75					
101-150	0	86	100	83	100	0	0	0	0	25					
151-200	-	-	-	-	-	-	-	-	-	-					
201-250	-	-	-	-	-	-	-	-	-	-					

Table 3: Breakdown of *Cornus sericea* 'Flaviramea' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	5	0	0	0	0	10	0	0	0	0	19	0	0	0	0
51-100	95	0	0	0	0	90	0	0	0	0	81	0	0	0	0
101-150	0	48	33	33	0	0	100	75	92	0	0	33	0	0	8
151-200	0	52	67	25	17	0	0	25	8	100	0	67	33	100	92
201-250	0	0	0	42	65	-	-	-	-	-	0	0	67	0	0
251 and +	0	0	0	0	18	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	42	0	0	0	0	24	0	0	0	0	100	14	0	0	0	10	0	0	0	0	95	0	0	0	0
51-100	58	0	0	0	0	76	29	8	0	0	0	86	0	0	0	90	0	0	0	0	5	90	0	0	0
101-150	0	67	33	67	0	0	71	42	67	0	0	0	87	92	0	0	52	42	67	0	0	10	100	50	25
151-200	0	33	67	33	63	0	0	50	33	33	0	0	13	8	100	0	48	58	33	100	0	0	0	50	75
201-250	0	0	0	0	37	0	0	0	0	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251 and +	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Corylus avellana X cornuta

See colour plate

Family	:	Betulaceae
English name	:	Hybrid hazelnut
French name	:	Noisetier hybride
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub with upright stems can reach a height of 3 to 5 m in Quebec.

The bark is beige and the young branches are glandular or pubescent.

The dark green leaves are pubescent, acuminate, and turn yellow-bronze in the fall.

The male catkins develop very early in the spring and are very decorative.

The fruits, hazelnuts, are edible.

ORIGIN AND DISTRIBUTION

This shrub of horticultural origin is the result of an artificial crossing between *Corylus avellana*, a European shrubby tree which produces an edible hazelnut, and *Corylus cornuta*, our indigenous hazelnut tree. It was introduced to the Montreal Botanical Garden in 1976 from seeds.

USE

Ornamental: This hybrid can be used standing alone or in clumps for the beauty of its catkins in the spring and for its edible hazelnuts. Like its parent *Corylus cornuta*, it can be used for naturalization purposes.

REQUIREMENTS

Hazelnuts must be planted very young since they do not tolerate transplanting well. They grow in all fertile, well-drained soils. They prefer sunny locations,

sheltered from the prevailing winds, but can tolerate light shade. Fruit production is higher in sunny locations.

PATHOLOGY

To our knowledge, no disease appears to affect this species.

PROPAGATION

This species can be propagated by digging up and transplanting the suckers that develop at the base of the older plants, or by layering, i.e. bringing the branches into contact with the ground so that they take root.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: British Columbia

Propagation site: Montreal Botanical Garden

Propagation technique: The plants were produced from seeds.

Inclusion in test network: Young seedlings 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Region 1

No damage was observed at Sainte-Clotilde.

Only one seedling suffered frost damage on the stem tips at the L'Assomption site on sand following the third winter.

At the L'Assomption site on clay, 20% of the seedlings suffered frost damage on the old wood following the fourth winter.

At Sainte-Anne-de-Bellevue, damage was observed the first three winters only. The first winter, 25% of the seedlings were affected by rodent damage, 30% suffered frost damage on the previous year's shoot and 35% suffered frost damage on the stem tips. The last two years, 10% and 67% of the seedlings, respectively, were affected by mild frost damage on the stem tips.

Region 2

At Sainte-Foy, only one seedling suffered frost damage on the stem tips during the first winter.

At Deschambault, 10% of the seedlings died the first winter and 17% suffered mechanical breakage the last winter. No other damage was observed.

At La Pocatière, the first two winters, frost damage on the previous year's shoot or on the old wood was observed on 10% to 45% of the seedlings. From 17% to 37% of the seedlings also suffered frost damage on the stem tips the first four winters. No damage was observed the last year.

Region 3

At Normandin, 15% of the seedlings were broken by the snow during the first winter and one seedling died the second winter. No other damage was observed during testing.

At Kapuskasing, 40% to 100% of the seedlings did not suffer any damage. However, 10% of the seedlings were damaged on the previous year's shoot during the first winter, 46% of the seedlings suffered frost damage on the stem tips and one seedling died the following winter. Mechanical breakage was observed on 8% and 58% of the seedlings, respectively, during the last two winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 2.48 m R2 = 1.82 m R3 = 1.16 m

The seedlings in region 1 were clearly higher than those in the other regions.

Categories

The average height of the shrubs after five years varied from one site to another:

2.51 - 2.75 m: Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand
 2.26 - 2.50 m: -
 2.01 - 2.25 m: Deschambault
 1.76 - 2.00 m: Sainte-Foy and L'Assomption on clay
 1.51 - 1.75 m: -

1.50 m and -: La Pocatière, Normandin and Kapuskasing

The seedlings at Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand were clearly higher than those at the other sites.

In general, the annual growth was approximately 50 to 60 cm in the second, third and fourth years. It was higher the last year. Annual growth at Sainte-Clotilde was higher. In addition, at La Pocatière and at Kapuskasing, growth was slow during the first two or three years but increased thereafter.

Effect of pruning

Pruning was greater than 50% of the year's shoot after the first winter. Thereafter, pruning was minor each year at all the sites.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.68 m R2 = 1.43 m R3 = 1.02 m

The seedlings in region 3 were clearly not as wide as those at the other stations.

Categories

The average width of the shrubs after five years varied from one site to another:

1.76 m and +: Sainte-Clotilde and L'Assomption on sand
 1.51 - 1.75 m: Sainte-Foy, Sainte-Anne-de-Bellevue and La Pocatière
 1.26 - 1.50 m: L'Assomption on clay
 1.01 - 1.25 m: Deschambault, Normandin and Kapuskasing

At all the sites, nearly a third of the seedlings had a more erect growth habit, thereby bringing down the averages obtained at the end of the season.

The growth of the seedlings was poorer on clay soils.

Annual growth was irregular from one year to another.

Corylus avellana X cornuta

RECOMMENDATIONS

Table 2 indicates the percentage of marketable seedlings by category at each test site, for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

The growth of this species was significantly faster at the sites in region 1, where the soil is suitable, particularly in zone 5b: at Sainte-Clotilde, 80% of the shrubs had attained a height greater than 1.00 m after two years. At the L'Assomption, Sainte-Anne-de-Bellevue, Sainte-Foy and Deschambault sites, three or four years were necessary to obtain a majority of seedlings with a height greater than 100 m.

However, this crossing is not currently available in Quebec. The seed-producing plants are in British Columbia.

It is therefore possible to produce this edible hazelnut but the scarcity of the seeds limits our recommendations.

Use

Very few seedlings died during testing and winter damage was often limited to frost damage on the stem tips, even in zone 2a. This hybrid can be zoned as 2a based on the results obtained.

Regeneration of growth was fairly good, although 5% to 15% of the shrubs did not survive transplanting at five of the nine sites.

This species was more sensitive to the winter cold during its initial years of establishment.

BIBLIOGRAPHICAL REFERENCES

21, 56, 57, 60, 65, 71, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Marie-Fleurette Beaudoin, Biol.

Table 1: Frequency of winter damage observed on *Corylus avellana X cornuta* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	96						4			4	
L'Assomption-sand	98	2								2	
Ste-Anne-de-Bellevue	27	62	6						5	73	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	95					2		3		5	
Sainte-Foy	99	1								1	
La Pocatière	59	22	10			2	7			41	
REGION 3											
Normandin	96					1		3		4	
Kapuskasing	67	16	2			2		13		33	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 6 and 7 occurred in this species.

Table 2: Breakdown of *Corylus avellana X cornuta* seedlings by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-100	100	94	27	0	0	94	100	36	18	0	72	19	0	0	0	95	45	0	0	0					
101-200	0	6	73	82	9	6	0	64	82	63	28	81	92	42	0	5	55	100	50	0					
201-300	0	0	0	18	63	0	0	0	0	37	0	0	8	58	100	0	0	0	50	75					
301-400	0	0	0	0	28	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	100	80	38	13	0	100	95	33	0	0	0	100	100	36	18	100	95	75	17	8	100	100	100	67	42
101-200	0	20	62	75	87	0	5	67	100	25	0	0	0	64	82	0	5	25	83	92	0	0	0	33	58
201-300	0	0	0	12	13	0	0	0	0	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cotoneaster apiculatus Rehd. and Wils.

See colour plate

Family	:	Rosaceae
English name	:	Cranberry cotoneaster
French name	:	Cotonéastre
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This small shrub, with a wide and prostrate growth habit, can grow to a height of 0.5 to 1.0 m and a width of 1.0 to 2.0 m. The branches are arched. The young stems are reddish and slightly pubescent, becoming brownish-grey as they get older. When broken, they give off an odour of maraschino cherries.

The alternate, entire and suborbicular leaves are 0.5 to 1.5 cm long and wide. They are glabrous when mature or only ciliate. The foliage is glossy dark green on the upper surface and slightly pubescent underneath. It turns red in the fall.

The small, solitary, pink and almost sessile flowers appear in late spring.

The fruits are abundant, solitary and red when ripe.

ORIGIN AND DISTRIBUTION

Etymology: The genus name comes from the Latin word *Cotonea* which means "quince tree" and from the Greek word *aster* which means "similar to." This species originates in western China and has been known in the West since 1901.

USE

Ornamental: This species can be used as ground cover or standing alone in a rock garden.

REQUIREMENTS

This species transplants more easily when it is cultivated in a container. It prefers moist, well-drained soils, but

adapts to all soil types except where the pH is too high. Once established, it can tolerate drought.

Its growth is slow, but can be accelerated when the plant is young by optimizing fertilization and watering.

PATHOLOGY

Mites can be observed when the plants are exposed to drought situations. Bacterial blight can also occasionally affect this species.

PROPAGATION

Seedlings: The seeds must be scarified in acid for 60 minutes then stratified for 60 days at 5°C. The endocarp is very hard and the degree of hardness varies depending the species of *Cotoneaster*. Sown in planting beds, in the fall, the seeds can take two to three years to germinate.

Propagation by cuttings: Using softwood cuttings is a good method for propagating this species.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 330 cuttings of approximately 12 cm were taken on July 6, 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator on a substrate composed of peat (40%) and perlite (60%). The rooting rate was 94% after 39 days. The cuttings were potted on August 6 and 14 in Fertil Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 15 and 25 and growth continued during the fall. The plants overwintered in the frame under a thick cover of snow. The winter survival rate was 99%; 256 plants were transplanted to the nursery in May 1985 and the recovery rate was 100%. They were dug up on May 2, 1986, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 8 to 10 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption on sand and L'Assomption on clay sites, damage was very severe during the third and fourth winters. At the first site, 72% and 50% of the plants suffered frost damage down to the ground surface and 28% and 33% of the plants suffered frost damage on the stem tips. At the second site, all the plants suffered frost damage down to the ground surface the third winter; 67% of the plants suffered browning of the foliage the fourth winter and the other plants died. In addition, 62% of the living plants died the following winter.

At Sainte-Clotilde, no damage occurred the first and fourth winters, but all the plants suffered frost damage on the previous year's shoot the second and third winters. The last winter, all the plants exhibited browning of the foliage.

Region 2

At Deschambault, the main damage was browning of the foliage every winter. However, 67% and 75% of the plants did not suffer any damage the last two winters.

At Sainte-Foy, frost damage down to the level of snow cover and/or down to the ground surface affected all the plants the second and third winters, and 67% and 33% of the plants the last two winters. In addition, 20% and 35% of the plants suffered browning of the foliage during the first and last winters.

At La Pocatière, 80% of the plants died the first winter and damage from foliage browning occurred almost every year on the plants that survived.

Region 3

At Normandin, only one plant died, during the second winter. Frost damage on the stem tips was the main damage observed, on almost all the plants following the first, second and fourth winters.

At Kapuskasing, almost all the plants suffered browning of the foliage every winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 18 cm R2 = 16 cm R3 = 18 cm

Categories

The average height of the shrubs after five years varied very little from one station to another:

21 cm and + : Deschambault, L'Assomption on sand and Sainte-Clotilde
 16 - 20 cm: Normandin and Kapuskasing
 10 - 15 cm: Sainte-Foy, L'Assomption on clay and La Pocatière

Effect of pruning

Pruning was carried out according to the severity of winter damage and the elimination of dead wood was the only limiting constraint.

Growth in width

After five years, the average width for each region was:

R1 = 1.12 m R2 = 0.97 m R3 = 0.98 m

The results for the L'Assomption site on clay are not included in the average for region 1, since they were too variable.

The La Pocatière site substantially brought down the average for region 2.

Categories

The average width of the shrubs after five years varied from one station to another:

1.51 m and + : Sainte-Foy
 1.01 - 1.50 m: Sainte-Clotilde, Deschambault and Normandin
 0.75 - 1.00 m: Kapuskasing, L'Assomption on sand and La Pocatière

Cotoneaster apiculatus* Rehd. and Wils. ...*RECOMMENDATIONS**

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

It is rare to obtain plants more than 30 cm high even after five years of growth. In terms of width, the plants were comparable at all the sites after two years, except at La Pocatière and Kapuskasing, where they were smaller.

In Quebec, the production of young plants in the field is risky unless it is done in situations where the snow forms a protective cover very early, by late fall.

Use

This species requires sufficient snow cover to blanket the branches and branchlets. Otherwise, serious damage from browning and frost damage on the stems can affect the plants' appearance. According to the American system, this species is zoned 4, which is equivalent to Canadian zone 5b.

In light of the test results, mortality was caused mainly by poor pedological conditions. Since damage was very severe at all the sites, even in zone 5a, it is probable that a zone rating of 5b is more appropriate for this species.

BIBLIOGRAPHICAL REFERENCES

4, 12, 27, 49, 50, 57, 58, 101, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Raynald Drapeau, Agr.

Table 1: Frequency of winter damage observed on *Cotoneaster apiculatus* from 1986 to 1991

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	13	34			20	19				14	87
L'Assomption-sand	13	50			25						87
Sainte-Clotilde	40		40							20	60
REGION 2											
Deschambault	36							2		62	64
Sainte-Foy	30			47	13					10	70
La Pocatière	33					16				51	67
REGION 3											
Normandin	36	62				2					64
Kapuskasing	3									97	97

- ^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 splitting |
| 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 types 3, 5, 10 and 11 occurred for this species.

Table 2: Breakdown of *Cotoneaster apiculatus* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-10	14	5	0	0	8	24	19	0	0	67	57	0	0	0	0										
11-20	86	95	50	50	42	76	81	75	72	33	43	100	100	33	92										
21-30	0	0	50	42	25	0	0	25	28	0	0	0	0	67	8										
31 and +	0	0	0	8	25	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-10	14	0	25	0	25	52	5	8	8	0	70	50	0	0	67	71	30	0	8	8	53	33	8	33	8
11-20	86	100	75	100	75	48	95	59	92	67	30	50	100	100	33	29	70	75	92	58	47	53	67	67	50
21-30	-	-	-	-	-	0	0	25	0	17	-	-	-	-	-	0	0	25	0	34	0	14	25	0	42
31 and +	-	-	-	-	-	0	0	8	0	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Cotoneaster apiculatus* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	76	0	0	8	16	67	0	8	82	100	67	0	0	0	0
51-100	24	71	42	83	84	33	100	92	18	0	33	67	8	0	0
101-150	0	29	58	9	0	-	-	-	-	-	0	33	92	58	100
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	42	0

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	43	0	0	0	0	62	0	0	0	0	95	100	33	0	0	100	0	17	17	0	33	71	8	0	0
51-100	57	5	8	0	0	38	100	58	83	0	5	0	67	100	100	0	100	67	58	50	67	29	75	34	67
101-150	0	95	92	67	0	0	0	42	17	92	-	-	-	-	-	0	0	16	25	50	0	0	17	42	33
151-200	0	0	0	33	100	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	0	0	0	24	0

Cotoneaster dammeri 'Skogholm'

See colour plate

Family	:	Rosaceae
English name	:	Skogholmen bearberry cotoneaster
French name	:	Cotonéastre
Category	:	Evergreen plant
Subdivision	:	Climbing or creeping plant

BOTANICAL DESCRIPTION

This creeping or semi-creeping plant can reach a height of 80 cm and a diameter of 3 m in eight or ten years. Its horizontal branches take root on contact with the ground.

The persistent foliage is green during the summer season and turns orangey-yellow in the fall. The leaves are approximately 2.5 cm long.

The small, solitary, pure white flowers with dark anthers are followed, in the fall, by small, bright red berries.

ORIGIN AND DISTRIBUTION

This species is originally from central China and was introduced by Wilson in 1900. It grows well throughout Europe.

USE

Ornamental: This cultivar forms a good ground cover and, because of the density of its foliage, it chokes weeds, thereby reducing maintenance.

REQUIREMENTS

The cotoneasters are among the evergreen plants which prefer slightly alkaline and fairly dry soil. They like sunny exposures or very light shade.

PATHOLOGY

To our knowledge, no disease appears to seriously affect this cultivar.

PROPAGATION

Propagation by cuttings: This is the only propagation technique which is successful in producing cultivars. In the United States, cuttings of 10 to 15 cm taken in July, treated with a #2 hormone powder, yielded a rooting rate of 90% to 99%. When the cuttings were taken in June or August, the success rate was lower. A hormone solution of 2,000 to 4,000 ppm IBA also yields good results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 426 cuttings of 8 cm were taken on June 28, 1984 and treated with a solution of 4,000 ppm IBA. They were placed in a mist propagator on a substrate composed of peat and perlite (2:3). The rooting rate was 100% after four weeks. On July 23, the plants were potted and placed in a greenhouse. A fertilizer solution (10-52-10) was applied after potting. Growth continued during the fall. The plants overwintered in a snow-covered frame and the survival rate was 100%. They were shipped on May 7, 1985.

Inclusion in test network: Young plants 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

There was little or no mortality in regions 1 and 2. However, mortality was very high at the two sites in region 3.

Almost all the plants suffered winter damage every year with a few exceptions.

Region 1

At the L'Assomption sites on sand and on clay, 57% and 100% of the plants exhibited frost damage down to the level of snow cover following the first winter. All the plants suffered frost damage down to the ground surface the last two winters. The two following winters, damage was limited to the stem tips or to the previous year's shoot.

At Sainte-Clotilde, damage was limited to the stem tips the first winter and to the previous year's shoot the second winter. All the plants suffered frost damage down to the level of snow cover or ground surface the last three winters.

The results obtained at Sainte-Anne-de-Bellevue were similar to those at Sainte-Clotilde with the exception of the fact that the plants there suffered no damage during the second winter.

Region 2

At Sainte-Foy, in almost all cases, the plants suffered frost damage down to the level of snow cover and ground surface every year; approximately 20% of the plants were affected by rodents the second winter and 25% of the plants did not suffer any damage the last winter.

At Deschambault, all the plants suffered damage, varying from one year to another. The stems tips were affected following the first winter, all the plants suffered foliage browning the third winter, they suffered frost damage down to the ground surface the fourth winter, and the previous year's shoot was affected the last winter.

At La Pocatière, the plants suffered browning of the foliage three winters out of five. The other two winters, they suffered frost damage down to the level of snow cover.

Region 3

Mortality was very high at Normandin: 67% of the plants died following the second winter and 43% of the remaining plants died the next winter. The four plants that survived suffered frost damage on the stem tips or on the previous year's shoot during the last two winters.

At Kapuskasing, 50% of the plants died following the first winter and those that survived suffered frost damage on the previous year's shoot. Thereafter, the plants suffered frost damage down to the ground surface and suffered browning of the foliage the last three winters.

Growth in height

After five years, the average height of the plants for each region was:

R1 = 0.64 m R2 = 0.62 m R3 = 0.45 m

The Deschambault site significantly lowered the average height for region 2.

Categories

The average height of the plants varied from one site to another:

0.71 - 0.80 m: Sainte-Anne-de-Bellevue (4 years) and La Pocatière (4 years)
 0.61 - 0.70 m: Sainte-Clotilde (3 years) and Sainte-Foy (4 years)
 0.51 - 0.60 m: L'Assomption on sand (3 years) and L'Assomption on clay (4 years)
 0.41 - 0.50 m: Deschambault (3 years) and Normandin (5 years)
 0.31 - 0.40 m: Kapuskasing (3 years)

Because of the winter frost damage, suffered particularly during the final years, the plants had to be cut back close to the ground. The height obtained at the end of testing is not necessarily the maximum height.

The number in parentheses therefore indicates the number of years of testing necessary to obtain the highest plants at each site.

From the fourth year of testing, the plants at Sainte-Anne-de-Bellevue were significantly higher than those at the other sites.

Effect of pruning

Pruning was proportional to the severity of frost damage.

Growth in width

After four years, the average width of the plants for each region was:

R1 = 2.36 m R2 = 1.67 m R3 = 1.00 m

The Deschambault site substantially lowered the average for region 2.

The plants in region 1 were clearly wider than those in the other regions.

Cotoneaster dammeri 'Skogholm'

The width indicated is that observed after four years, since the plants were pruned severely the final year in order to facilitate digging up of the plants at the end of the testing.

The width of the plants increased at all the sites during the first four years. The width of the plants at the Kapuskasing, Deschambault and Normandin sites was clearly less than that of the plants at the other sites.

From the third growing season, the width of the plants at Sainte-Clotilde was significantly greater than that of the plants at the other sites.

Annual growth was poorer at the two sites in region 3.

Categories

The average width of the plants after four years varied from one site to another:

- 3.01 m and +: Sainte-Anne-de-Bellevue
- 2.51 - 3.00 m: L'Assomption on sand
- 2.01 - 2.50 m: Sainte-Foy
- 1.51 - 2.00 m: L'Assomption on clay, La Pocatière and Sainte-Clotilde
- 1.01 - 1.50 m: Deschambault and Normandin
- 1.00 m and -: Kapuskasing

Flowering

At the sites in region 1, the plants flowered in 1986, 1987 and 1988. No flowering was observed in 1989. The first flowers appeared between May 30 and June 6. This flowering lasted 10 to 20 days and was not very conspicuous. Mid-flowering occurred from four to five days after the beginning of flowering.

At the sites in region 2, the first flowers appeared between June 8 and 16 and the duration of flowering was 10 to 20 days, depending on the sites and the years. The peak flowering period lasted from six to ten days. The plants flowered at these sites mainly the first two or three years.

In region 3, only a few plants flowered in 1988 and 1989. The first flowers bloomed between June 16 and 26. The plants were in flower from 14 to 17 days.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site, for the final width obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined width.

Production

Height cannot be considered a significant criterion for sales or production since, at all the sites, the plants were cut back to the ground surface or the level of snow cover every spring.

All the plants at the sites in region 1 and at La Pocatière had a width greater than 1.0 m after two years. At Sainte-Foy, a third year was necessary in order for all the plants to reach this width. At Deschambault, after a fourth year, this percentage was only 83%. At Normandin, even after five years, only 50% of the plants had attained this width.

Production is therefore faster at the sites with climatic conditions equivalent to region 1.

Use

This cultivar, zoned 3 in Buckley's book, suffered serious winter frost damage at all the sites in zones 2a, 2b, 4a and 5. However, mortality was low except in zone 2.

The zone rating of 3 can be left unchanged if only survival is taken into account. However, this cultivar suffered frost damage every year or almost every year and the severity of the damage was related to the thickness of the snow cover when the temperature fell below the stems' threshold of tolerance to cold. The root system stood up well to the test conditions and the plant's annual growth makes it an excellent ground cover. However, this plant required severe annual pruning to remove the frost-damaged wood.

BIBLIOGRAPHICAL REFERENCES

3, 13, 17, 23, 37, 39, 47, 60, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Cotoneaster dammeri* 'Skogholm' from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	3	30	7	20	38	2					97
L'Assomption-sand	3	45		12	40						97
Ste-Anne-de-Bellevue	19	20		60		1					81
Sainte-Clotilde	0	20	18	40	20	2					100
REGION 2											
Deschambault	2	25	23		25					25	98
Sainte-Foy	5			71	20				4		95
La Pocatière	0			40						60	100
REGION 3											
Normandin ^b	43	20	15			22					57
Kapusksing ^c	0		12		22	10				56	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 splitting |
| 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 types 3, 5, 9 and 10 occurred for this species.

^b Only seven plants survived the second winter and the average was calculated on four plants over the last three years.

^c The average was calculated on six plants over the last three years.

Table 2: Breakdown of *Cotoneaster dammeri* 'Skogholm' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	33	0	0	0	8	0	0	0	0	54	0	0	0	0	0	86	0	0	0	0					
51-100	67	0	0	0	42	90	0	0	0	46	100	5	0	0	0	14	0	0	0	0					
101-150	0	38	0	0	42	10	100	16	0	0	0	95	0	8	33	0	24	0	0	0					
151-200	0	62	33	9	8	0	0	84	67	0	0	0	100	92	67	0	76	8	0	0					
201-300	0	0	67	83	0	0	0	0	33	0	-	-	-	-	-	0	0	92	8	100					
301 and +	0	0	0	8	0	-	-	-	-	-	-	-	-	-	-	0	0	0	92	0					
Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	23	0	0	0	8	48	0	0	0	0	43	100	0	0	0	71	0	0	0	0
51-100	19	43	0	0	42	77	81	83	17	67	52	0	0	0	17	57	0	100	100	50	29	100	83	67	100
101-150	76	28	16	0	58	0	19	17	75	25	0	100	33	25	83	0	0	0	0	50	0	0	17	33	0
151-200	5	29	84	67	0	0	0	0	8	0	0	0	67	50	0	-	-	-	-	-	-	-	-	-	-
201-300	0	0	0	33	0	-	-	-	-	-	0	0	0	25	0	-	-	-	-	-	-	-	-	-	-
301 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cotoneaster horizontalis var. *perpusillus* Schneid

See colour plate

Family	:	Rosaceae
English name	:	Cotoneaster
French name	:	Cotonéastre horizontal
Category	:	Semievergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This dwarf shrub, with a creeping growth habit, can grow to a width of 1.0 m and a maximum height of 0.6 m.

The horizontal branches are covered with a woolly down. They are less regularly palmate than those of the type species.

The leaves are 6 to 8 mm long and the margin is wavy. They are rounded, mucronate, shiny dark green above and glaucous beneath. They turn orangey-red in the fall and fall very late.

The flowers are very small, pink and in clusters of two.

The small elliptical fruits are 5 to 6 mm long and usually contain three seeds. They become vivid red in the fall.

ORIGIN AND DISTRIBUTION

The species name comes from the Latin word *Cotonea* which means "quince tree" and from the Greek word *aster* which means "similar to," alluding to the resemblance between certain species of this genus and the quince tree.

This variety comes from the barrens of central China and was discovered around 1908.

USE

Ornamental: This variety can be used in small gardens, rock gardens and wall gardens.

REQUIREMENTS

This species prefers sunny or semi-shady sites.

PATHOLOGY

To our knowledge, this variety is little affected by diseases or insects.

PROPAGATION

Propagation by cuttings: This variety propagates easily by softwood cuttings, treated with a rooting hormone.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: Cuttings of 10 cm were taken in July 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator on a substrate composed of peat (40%) and perlite (60%). The plants were potted in August in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame in August and growth continued during the fall. The plants overwintered in the frame under a thick cover of snow. The winter survival rate was 99%. The plants were transplanted to the nursery in May 1985 and the recovery rate was 100%. They were dug up in May 1986, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 12 to 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the l'Assomption site on sand, more than 85% of the plants did not suffer any damage three winters out of five. However, during the third winter, 67% of the plants suffered frost damage on the stem tips. The fourth winter, 92% of the plants were affected by various types of damage, ranging from slight damage to severe damage.

At the l'Assomption site on clay, all the plants suffered severe frost damage except during the first year. In addition, rodents damaged 100%, 73% and 70% of the plants during the second and last two winters.

At Sainte-Clotilde, no damage was observed four winters out of five. All the plants suffered frost damage on the stem tips the fourth winter.

Region 2

At Sainte-Foy, damage was limited to frost damage on the stem tips on 58% of the plants the last winter and to damage caused by rodents on 33% of the plants the third winter.

At Deschambault, the behaviour was relatively similar; 50% of the plants suffered frost damage on the previous year's shoot the fourth winter and 17% of the plants suffered damage caused by rodents the third winter.

At La Pocatière, no plants survived the five years of testing and this mortality is attributable to the effect of soil compaction in these plots. The gradual mortality of the plants nonetheless enabled us to observe frost damage on several of the plants which survived for a certain amount of time.

Region 3

At Normandin, plant mortality was observed following the first two winters on 24% and 6% of the plants. Mild frost damage was noted on 76% and 60% of the plants following the first and fourth winters.

At Kapuskasing, conditions during the third winter resulted in frost damage to the stem tips on 33% of the plants and frost damage on the previous year's shoot on

33% of the plants. The following year, 92% of the plants again exhibited mild frost damage.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 44 cm R2 = 40 cm R3 = 27 cm

The l'Assomption on clay and La Pocatière sites brought down their respective regional averages.

Categories

The average height of the shrubs after five years varied from one station to another:

51 cm and + : Sainte-Clotilde
 41 - 50 cm : Deschambault, L'Assomption on sand and Sainte-Foy
 31 - 40 cm : -
 30 cm and - : Kapuskasing, L'Assomption on clay, La Pocatière and Normandin

The height was clearly lower at the sites with clay soil.

Effect of pruning

Pruning involved the portions of stems damaged by frost.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 98 cm R2 = 99 cm R3 = 83 cm

The average width in each region was slightly less than 1 m after five years.

Categories

The average width of the shrubs after five years varied from one station to another:

1.26 m and + : Deschambault and Sainte-Clotilde
 1.01 - 1.25 m : Sainte-Foy
 0.75 - 1.00 m : Normandin, L'Assomption on sand and on clay, Kapuskasing and La Pocatière

Cotoneaster horizontalis var.
perpusillus Schneid

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site, for the final width obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined width.

Production

In general, after two years of growth, 80% or more of the plants were 0.50 to 1.00 m wide. The production of this variety is possible where pedological conditions permit and where the snow cover begins early in the fall and remains throughout the cold period. It was in the Sainte-Clotilde region that the plants suffered the least damage.

Use

The test results demonstrated that this variety can survive and develop successfully in all regions of Quebec provided that the plants are covered by a sufficient thickness of snow during the periods of most intense cold.

Moreover, even though this variety exhibited very little damage at Sainte-Clotilde (5a), the zone rating of 6, assigned by Sherk and Buckley, seems consistent with the cold tolerance potential of this species in open winter conditions.

BIBLIOGRAPHICAL REFERENCES

12, 57, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Raynald Drapeau, Agr.

Table 1: Frequency of winter damage observed on *Cotoneaster horizontalis* var. *perpusillus* from 1986 to 1991

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	20			15	19	3			43		80
L'Assomption-sand	63	22	3	7		1	2		2		37
Sainte-Clotilde	80	20									20
REGION 2											
Deschambault	84			12					4		16
Sainte-Foy	81	12							7		19
La Pocatière	34	29	6			30	1				66
REGION 3											
Normandin	67	27				6					33
Kapuskasing	59	31	8					2			41

- ^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 splitting |
| 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 types 3, 9, 10 and 14 occurred for this species.

Table 2: Breakdown of *Cotoneaster horizontalis* var. *perpusillus* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	100	5	16	16	33	95	14	16	27	90	100	14	0	0	0										
51-100	0	95	84	42	17	5	86	84	27	10	0	86	25	0	0										
101-150	0	0	0	42	50	0	0	0	46	0	0	0	75	100	100										
151 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	43	0	0	0	0	67	0	0	0	0	100	100	70	40	22	100	31	30	30	10	95	5	0	0	17
51-100	57	48	8	75	33	33	100	83	50	0	0	0	30	50	67	0	69	30	70	50	5	95	75	75	66
101-150	0	52	92	25	67	0	0	17	50	83	0	0	0	10	11	0	0	40	0	40	0	0	25	25	17
151 and +	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Elaeagnus angustifolia L.

See colour plate

Family	:	Eleagnaceae
English name	:	Russian olive
French name	:	Olivier de Bohême, chalef à feuilles étroites
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This small tree or large erect shrub, with a single trunk or multiple trunks, can attain a height of 7 to 9 m and a width of 3 to 4 m. When it develops several trunks, it becomes crooked and gnarled with age.

The bark is greenish-grey and smooth when the plants are young, becoming dark brown and jagged or scaly when mature.

The young branches are silvery, becoming shiny brown, generally thorny and covered with scales. The older stems are pale grey and resinous.

The stalkless grey-brown buds are small, solitary, round, conical or oblong and covered with about four silvery scales.

The greyish-green or silvery-grey leaves are alternate, deciduous, lanceolate or ovate, and are 4 to 8 cm long. The petiole is 5 to 8 mm long. The foliage is light.

In May, the branches are covered with numerous small fragrant flowers, in clusters of two or three at the leaf axil of young shoots. They are silvery yellow outside, yellow inside, and are 1 cm long. In late summer or early fall, sweet, edible yellow berries form covered with numerous silvery scales. Birds are very fond of the berries, which remain on the tree until the birds have eaten them.

ORIGIN AND DISTRIBUTION

This species originates in southern Europe and central and western Asia. It is found from the Altai Mountains to the Gobi desert. It has been cultivated since the 16th century in southern Europe and central Asia, in the Himalayas and in China. It is even being tested in Tunisia and the western Sahara.

In North America, it is found throughout the United States as well as in eastern Canada and in Mexico. It can tolerate altitudes of up to 2,600 m and temperatures as low as -40°C.

It has a lifespan of approximately 50 to 80 years.

USE

Ornamental: The Russian olive is used in clumps or standing alone to highlight the colours of its foliage and bark. When placed at the back of a garden, the shimmering of its leaves gives an impression of depth. Multi-trunked specimens provide a robust screen in locations exposed to the wind.

Naturalization: This species is also used as a thorny hedge. It fixes nitrogen and can help improve poor soils.

Food uses: A high-quality honey can be produced from its flowers.

Ornithology: Birds are very fond of its fruit.

Medicinal: It has astringent properties.

REQUIREMENTS

This olive tree is highly adaptable and does well in all climates. It must be exposed to the sun to maintain the colours of its foliage. It grows in almost all well-drained soils and can tolerate dry and acidic environments, clay-limestone soils, drying wind, as well as urban pollution.

It has a fairly rapid rate of growth. The small branches inside the shrub are choked by the larger outside branches; they must be removed, regardless of the time of year.

PATHOLOGY

It is occasionally affected by certain types of leaf spots, canker on the trunk (*Nectria cinnabarrina*) and a rust.

PROPAGATION

Seedlings: The seeds can be sown as early as the fall or stratified for 60 to 90 days at 5°C. It is easily possible to obtain 1,000 seedlings per kg of seed.

Propagation by cuttings: Cuttings taken in mid-October and treated with a hormone solution of 40 ppm IBA for two hours yield a low rooting rate.

It can also be propagated by suckers and by layering.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: City of Montreal, Quebec

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

Propagation technique: The seeds were sown in a greenhouse on June 1, 1983, after being soaked in water for two weeks. After emergence, the seedlings were transferred to individual cells and placed outside until the fall. On June 6, 1984, they were transplanted and cultivated in the nursery. In May 1985, they were dug up, puddled, wrapped and placed in a cold store until they were shipped.

Inclusion in test network: Young seedlings 11 to 14 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

A few seedlings died in each region; this mortality occurred following the last two winters in regions 1 and 2.

Region 1

Most of the seedlings did not suffer any winter damage during the test period, except at Sainte-Anne-de-Bellevue. At this site, mild frost damage on the stem tips

occurred following the last three winters, on 92% of the seedlings.

Region 2

At Deschambault, mechanical breakage occurred following the last three winters, affecting 8% to 83% of the seedlings. Two seedlings died, one the last winter and the other the previous winter.

At Sainte-Foy, mortality occurred at the same time as at Deschambault, but at a rate of two seedlings per winter. The seedlings were affected only by mild frost damage on the stem tips, just like at La Pocatière.

Region 3

At Normandin, between 42% and 100% of the seedlings did not suffer any damage each winter. Following the winter of 1987-1988, 60% of the seedlings were affected on the previous year's shoot. In addition, three winters out of five, some of the seedlings were damaged by the accumulation of snow.

At Kapuskasing, all types of damage were observed over the years. Seedlings died every year, particularly following the winter of 1987-1988.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.33 m R2 = 2.74 m R3 = 1.37 m

The height differed significantly from one region to another.

Categories

The average height of the trees after five years varied from one site to another:

4.01 m and +:	Sainte-Clotilde
3.51 - 4.00 m:	-
3.01 - 3.50 m:	Sainte-Anne-de-Bellevue, L'Assomption on sand and Deschambault
2.51 - 3.00 m:	La Pocatière and L'Assomption on clay
2.01 - 2.50 m:	Sainte-Foy
1.51 - 2.00 m:	Normandin
1.01 - 1.50 m:	-
0.51 - 1.00 m:	Kapuskasing

Elaeagnus angustifolia L.

The seedlings in region 1 were, on average, significantly higher.

Effect of pruning

This species required little pruning, and only to eliminate damage caused by rodents, snow or frost damage.

Growth in width

After five years, the average width for each region was:

R1 = 2.66 m R2 = 1.86 m R3 = 1.28 m

Categories

The average width of the trees after five years varied from one site to another:

- 3.01 m and +: L'Assomption on sand
- 2.51 - 3.00 m: Sainte-Clotilde and Sainte-Anne-de-Bellevue
- 2.01 - 2.50 m: La Pocatière
- 1.51 - 2.00 m: Deschambault, L'Assomption on clay and Sainte-Foy
- 1.01 - 1.50 m: Normandin and Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

It is possible to obtain plants with a height of 1 to 2 m at all the sites in regions 1 and 2 after only two years. However, to obtain plants of greater height, region 1 is more competitive: the growth of this species is influenced by the favourable weather conditions in this region, which make it possible to produce large specimens quickly.

Use

The 2b zone rating reported by Sherk and Buckley is quite appropriate, since the damage suffered at Normandin was less than that suffered at Kapuskasing, where the climate is equivalent to a 2a rating. At the latter site, this species was frequently affected by damage and is therefore not suitable for use there.

This thorny species can be pruned but this causes it to lose some of its ornamental interest, since the fruits are then hidden or removed. This plant must be allowed to grow freely in order to conserve all its ornamental qualities.

BIBLIOGRAPHICAL REFERENCES

3, 11, 13, 16, 21, 27, 47, 56, 57, 60, 71, 86, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Elaeagnus angustifolia* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage							Cumulative damage	
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	87	13								13
L'Assomption-sand	92	6						2		8
Ste-Anne-de-Bellevue	34	56					3		7	66
Sainte-Clotilde	100									0
REGION 2										
Deschambault	67					4		29		33
Sainte-Foy	18	72				7			3	82
La Pocatière	20	80								80
REGION 3										
Normandin	73		12						15	27
Kapuskasing	18	32	13	7	4	15	7	4		82

- ^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 splitting |
| 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 occurred for this species.

Table 2: Breakdown of *Elaeagnus angustifolia* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-100	90	0	0	0	0	100	14	0	0	0	95	0	0	0	0	100	10	0	0	0					
101-200	10	100	25	8	0	0	86	67	50	17	5	100	8	8	0	0	90	33	17	9					
201-300	0	0	75	25	64	0	0	33	50	50	0	0	75	0	8	0	0	67	75	9					
301-400	0	0	0	67	27	0	0	0	0	33	0	0	17	92	17	0	0	0	8	73					
401 and +	0	0	0	0	9	-	-	-	-	-	0	0	0	0	75	0	0	0	0	9					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	90	5	8	8	0	90	0	0	0	0	100	29	0	0	0	100	85	8	0	0	100	100	75	34	60
101-200	10	95	58	50	0	10	100	83	8	0	0	71	100	25	8	0	15	92	92	92	0	0	25	66	40
201-300	0	0	34	33	71	0	0	17	75	36	0	0	0	75	17	0	0	0	8	8	-	-	-	-	-
301-400	0	0	0	9	29	0	0	0	17	64	0	0	0	0	75	-	-	-	-	-	-	-	-	-	-
401 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Elaeagnus angustifolia* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	43	0	0	0	0	90	29	0	0	0	100	0	0	0	0	100	5	0	0	0
101-200	57	85	0	0	8	10	71	83	100	83	0	95	75	0	0	0	95	33	17	9
201-300	0	15	100	92	33	0	0	17	0	17	0	5	25	83	58	0	0	67	66	45
301-400	0	0	0	8	42	-	-	-	-	-	0	0	0	17	42	0	0	0	17	46
401 and +	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	100	10	8	34	0	81	0	0	0	0	100	24	0	0	0	100	85	0	0	17	100	100	87	33	40
101-200	0	90	58	58	87	19	100	100	25	54	0	76	92	0	33	0	15	100	100	83	0	0	13	67	60
201-300	0	0	34	8	13	0	0	0	75	46	0	0	8	100	67	-	-	-	-	-	-	-	-	-	-
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Elaeagnus commutata Bernh.

See colour plate

Family	:	Eleagnacea
English name	:	Silverberry, wolf willow
French name	:	Chalef argenté, chalef changeant
Synonym	:	<i>Elaeagnus argentea</i> Pursh
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This wide shrub, with an erect growth habit and a rounded crown, can attain a height of 4 m. It takes the form of a small shrub or a clump of shrubs.

The branches are silvery with orange flecks, with scales but no thorns. The bark cracks into thin, dark grey longitudinal strips.

The deciduous leaves are alternate, narrow, oval, crispate, shiny and silvery on both sides. They are 3 to 10 cm long, and 2 to 4 cm wide. The petiole is short.

Flowering is abundant in May and continues until July. The numerous delicately fragrant flowers are golden yellow inside and silvery outside. They are solitary and pendent or in clusters of two, three or four on the young shoots. They are about 1 cm long and are hermaphroditic.

The fruits are silvery-white ovoid drupes, becoming pinkish when mature, and are 1 cm long. They ripen in the fall and are edible but mealy.

This species sends out many suckers. Nodules, due to the action of a parasitic fungus, are frequently observed on the roots.

ORIGIN AND DISTRIBUTION

This indigenous species ranges from eastern Canada to the Northwest Territories, Minnesota, South Dakota and as far south as Utah. It was introduced for cultivation in 1813.

It is uncommon in Quebec; it is found in the natural environment in Temiscamingue, near Quebec City and on the Ile d'Orléans. It grows on escarpments, dry river banks and sandy sites.

It has a lifespan of approximately 80 to 100 years.

USE

Ornamental: This shrub is very interesting for its silvery foliage and because it tolerates poor soils. It is preferable to grow it freely as a shrub or in clumps, since it suckers easily and tends to form colonies.

Food uses: The fruits are edible.

REQUIREMENTS

This species is of interest since it tolerates all soil types well, even poor or dry soils, with the exception of overly acidic soils.

PATHOLOGY

The roots often have nodules due to the action of a parasitic fungus, but this does not seem to particularly affect the development of the species.

PROPAGATION

Seedlings: Good results are obtained using seeds from fresh fruits or seeds extracted from drupes. A fall seeding is preferable, but stratification in a cool, moist substrate, followed by a spring seeding, yields a germination rate of 60% to 85%.

Propagation by cuttings: This species can be propagated by softwood or semi-hard cuttings.

Suckering: This species propagates very easily by suckers.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Jardin de Métis, Métis, Quebec

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

Propagation technique: The seeds were sown in a greenhouse on June 1, 1983, after soaking in water for two weeks. After emergence, the seedlings were transferred to individual cells and placed outside until

the fall. On June 6, 1984, they were transplanted to the nursery. In May 1985, they were dug up, puddled, wrapped and stored until they were shipped a few days later.

Inclusion in test network: Young seedlings 15 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Very little damage was observed on this species, the most common being mechanical breakage or damage caused by rodents.

Region 1

No damage was observed at the sites in this region during the five years of testing, except at L'Assomption on clay, where one seedling died following the third winter. At this site, one or two seedlings occasionally suffered mild frost damage or mechanical breakage.

Region 2

At Sainte-Foy, there was no damage the first three winters. Damage caused by rodents was observed the last two winters, on 83% and 27% of the seedlings respectively. One seedling died the last winter as a result of damage caused by rodents.

At Deschambault, mechanical breakage occurred the last three winters.

Region 3

No frost damage was observed in this region, except on one seedling at Normandin.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.49 m R2 = 1.45 m R3 = 1.37 m

There was very little difference between the regional averages.

Categories

The average height of the shrubs after five years varied from one site to another:

1.51 - 1.75 m: Sainte-Anne-de-Bellevue and Sainte-Clotilde
1.26 - 1.50 m: Sainte-Foy, Deschambault, La Pocatière, L'Assomption on sand and on clay, Normandin and Kapuskasing

At Sainte-Clotilde, there was very little growth in height the last three years.

The final height of the seedlings at Sainte-Foy is based on the results for the first four years, since the seedlings were gnawed down to the ground following the last winter.

At Deschambault and at Normandin, there was little growth the last two years.

Effect of pruning

Pruning consisted almost exclusively in eliminating the suckers that grew between the plants in the rows and between the rows.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.14 m R2 = 1.26 m R3 = 0.88 m

The width of the seedlings was higher in region 2. It was limited by eliminating several suckers at each site in order to avoid harming the development of adjacent species.

Categories

The average width of the shrubs after five years varied from one site to another:

1.26 - 1.50 m: Sainte-Anne-de-Bellevue and La Pocatière
1.01 - 1.25 m: Sainte-Foy*, Sainte-Clotilde, L'Assomption on sand and Deschambault
0.76 - 1.00 m: Normandin and Kapuskasing
0.75 m and -: L'Assomption on clay

* Width attained after only four years.

Elaeagnus commutata* Bernh.*RECOMMENDATIONS**

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

The seedlings were quite heterogeneous and exhibited significant individual variation. However, after two years, the seedlings had attained a height of 50 to 100 cm at all the sites, except at Kapuskasing. At this site, a third year was necessary in order for all the seedlings to reach this height.

This fast-growing species can be produced competitively throughout Quebec.

Depending on the year, damage by rodents can severely affect production.

Use

This species, assigned a hardiness rating of 2 in the book by Sherk and Buckley, tolerated the climatic conditions at the site in hardiness zone 2a quite well, and growth there was quite promising.

In light of the test results, this species could even withstand harsher climates, such as those in zone 1.

BIBLIOGRAPHICAL REFERENCES

1, 3, 16, 27, 56, 57, 60, 65, 71, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Elaeagnus commutata* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	90	2	2			2	3	1		10	
L'Assomption-sand	100									0	
Ste-Anne-de-Bellevue	100									0	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	83							17		17	
Sainte-Foy	76					2			22	24	
La Pocatière	98	2								2	
REGION 3											
Normandin	98	2								2	
Kapuskasing	100									0	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 4, 6 and 7 occurred for this species.

Table 2: Breakdown of *Elaeagnus commutata* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	62	0	0	0	0	52	14	0	0	0	52	0	0	0	0	71	5	0	0	0
51-100	38	62	33	42	8	48	86	83	64	20	48	25	0	0	0	29	71	25	0	0
101-150	0	38	67	50	59	0	0	17	27	60	0	60	54	42	27	0	24	58	58	50
151-200	0	0	0	8	33	0	0	0	9	20	0	15	46	50	73	0	0	17	42	33
201-250	-	-	-	-	-	-	-	-	-	-	0	0	0	8	0	0	0	0	0	8
251 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	33	0	0	0	25	62	0	0	0	0	100	5	0	0	0	72	11	0	0	0	100	71	0	0	0
51-100	67	81	25	0	50	38	81	17	0	0	0	95	25	25	8	28	89	27	0	18	0	29	58	25	17
101-150	0	19	42	50	8	0	19	83	42	75	0	0	75	50	34	0	0	73	91	37	0	0	33	50	50
151-200	0	0	33	42	17	0	0	0	58	17	0	0	0	25	58	0	0	0	9	45	0	0	9	25	33
201-250	0	0	0	8	0	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Erica carnea 'Praecox'

See colour plate

Family	:	Ericaceae
English name	:	Spring heather
French name	:	Bruyère alpine or bruyère des neiges
Category	:	Evergreen plant
Subdivision	:	Climbing or creeping plant

BOTANICAL DESCRIPTION

This small ground-cover shrub can attain a height of 25 cm and a width of nearly 1 m.

The stems are spreading, with a large number of branches.

The leaves are persistent, needle-like and in whorled clusters of three to five.

The pinkish flowers are dense, with a large number of terminal racemes, and bloom before the snow has completely melted. The flower buds form in the fall on the year's shoot.

ORIGIN AND DISTRIBUTION

The species is originally from Europe.

USE

Ornamental: This cultivar is used mainly in clumps at the base of other acidophilic plants for its flowers.

REQUIREMENTS

The heathers prefer acidic and well-drained sandy or peaty soils, but tolerate limestone soils. They also tolerate shade, air pollution and even sea salt. The foliage is less dense in the shade and flowering less abundant.

They require a good layer of snow or adequate protection to withstand winter conditions.

They rarely need to be pruned, just clipped every two or three years.

PATHOLOGY

No particular disease appears to affect this cultivar.

PROPAGATION

Propagation by cuttings: Propagation by softwood cuttings is the only propagation method for cultivars.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Oka, Quebec

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

Propagation technique: Cuttings of 5 cm were taken on July 7, 1983 and treated with a solution of 5,000 ppm IBA. They were placed in a mist propagator on a substrate composed of peat and perlite. The rooting rate was 99% on July 25. The plants were potted in small pots on August 4. From October 21 to April 24, 1984, the cuttings were kept in a cold store at 5°C and 60% relative humidity under artificial light eight hours a day. The plants were placed in a greenhouse from April 24 to June 13, then placed outside. In May 1985, they were wrapped and placed in a cold store until they were shipped.

Inclusion in test network: Young plants 5 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality was total at the outset of testing at Normandin and at Kapuskasing. Mortality was gradual but almost total at Sainte-Anne-de-Bellevue and at L'Assomption on clay. Conditions during the fourth winter were particularly damaging at all the sites.

Region 1

At L'Assomption on sand, more than 80% of the plants did not suffer any damage four winters out of five. During the fourth winter, 10% of the plants suffered frost damage on the stem tips, 40% were affected on the old wood and 10% suffered frost damage down to the ground level. Four plants died during testing: two after

the second winter and the other two the following winter.

At L'Assomption on clay, more than 80% of the plants did not suffer any damage the first three winters. However, all the plants died during the last two winters.

At Sainte-Clotilde, no damage was observed the first two winters. Nonetheless, all the plants suffered frost damage on one year's shoot the third winter, on the old wood the fourth winter and down to the snow level the last winter.

At Sainte-Anne-de-Bellevue, the plants suffered little damage the first two winters. However, 90% of the plants suffered frost damage on the old wood the third winter, 70% died the following winter and the three remaining plants died or suffered frost damage the last winter.

Region 2

At Sainte-Foy, no damage was observed four winters out of five, except for the death of two plants. The fourth winter, 67% of the plants suffered frost damage down to the ground level and 33% of the plants died.

At Deschambault and at La Pocatière, almost no damage was noted the first three winters. The fourth winter, 100% and 33% respectively of the plants suffered browning of the foliage and 25% of the plants at La Pocatière died. The last winter, 67% of the plants at Deschambault suffered frost damage on the old wood and another plant died at La Pocatière.

Region 3

At Normandin, the plants did not suffer any damage the first winter but they all died the following winter.

At Kapuskasing, 80% of the plants died the first winter and the others the following winter.

Growth in height

After five years, the average height of the plants for each region was:

R1 = 0.12 m R2 = 0.18 m R3 = -

Categories

The average height of the plants after five years varied from one site to another:

0.21 - 0.25 m: Sainte-Clotilde and La Pocatière
 0.16 - 0.20 m: Deschambault
 0.11 - 0.15 m: Sainte-Foy and Sainte-Anne-de-Bellevue
 0.00 - 0.10 m: L'Assomption on sand and L'Assomption on clay

This creeping species attained its potential height only at Sainte-Clotilde and at La Pocatière.

Effect of pruning

Pruning was closely related to the extent of winter damage.

Growth in width

After five years, the average width of the plants for each region was:

R1 = 0.41 m R2 = 0.48 m R3 = -

The two L'Assomption sites brought down the average for region 1.

Categories

The average width of the plants after five years varied from one site to another:

0.61 - 0.70 m: Sainte-Clotilde
 0.51 - 0.60 m: Sainte-Foy
 0.41 - 0.50 m: Deschambault, Sainte-Anne-de-Bellevue and La Pocatière
 0.31 - 0.40 m: L'Assomption on sand
 0.21 - 0.30 m: -
 0.11 - 0.20 m: L'Assomption on clay

Flowering

At the two sites located south of Montreal, the flowering period began in the final days of March, while at L'Assomption, the first flowers were observed between April 9 and 24. The flowering period lasted from 20 to 45 days depending on the year and the site. Flowering was more intense during the last 20 or 25 days.

At the sites in region 2, flowering began between April 15 and May 5 and ended in late May. The total flowering period lasted approximately 20 to 30 days, while the peak flowering period lasted from 10 to 20 days.

<i>Erica carnea</i> 'Praecox'

On several occasions, a second flowering was noted in October before the first serious frosts. In addition, the date flowering began coincided with the first snowless days or with the first observations of the year.

RECOMMENDATIONS

Production

It is not necessary to present a table of marketable plants since all the sites produced plants with a width of 25 cm or more by the end of the first growing season.

The very high mortality at the sites in zones 2a and 2b rules out the production of this cultivar in more northerly zones.

Furthermore, without winter protection, this cultivar is likely to suffer heavy losses even in zone 5.

Use

The hardiness rating of 6 assigned to *Erica carnea* and its cultivars by Sherk and Buckley appears to be appropriate.

The test results demonstrated that the plants can be very severely affected when the snow cover is insufficient in zones 4 and 5. However, the plants performed quite well in zone 4 in protected locations.

Despite the winter damage, the flowering was very considerable every year at each of the sites in zones 4 and 5.

BIBLIOGRAPHICAL REFERENCES

3, 24, 60, 64, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Erica carnea* 'Praecox' from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage	
		WINTER DAMAGE ^a										
		2	4	6	7	8	5 and 9	10	11	14		
REGION 1												
L'Assomption-clay ^b	69	2				29						31
L'Assomption-sand	82	2			2	6	8					18
Ste-Anne-de-Bellevue ^b	30	13		6		26	22		3			70
Sainte-Clotilde	40		20	20			20					60
REGION 2												
Deschambault	58						17				25	42
Sainte-Foy	79				13	8						21
La Pocatière	82					9			2	7		18
REGION 3												
Normandin ^c	0					100						100
Kapuskasing ^c	0					100						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 splitting |
| 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 |

^b This percentage is valid only for the first three years.

^c All the plants died during first two winters.

Euonymus alatus 'Compactus'

See colour plate

Family	:	Celastraceae
English name	:	Dwarf winged spindle, burningbush
French name	:	Fusain compact
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This small shrub, with a wide and compact growth habit, can attain a height of more than 1 m and a width of up to 3 m. The branches are spreading and covered with four winged, suberous ridges which give it a squared shape. The new stems are green, becoming grey-brown as they get older.

The opposite, narrowly oval or obovate and almost sessile leaves are twice as long as wide. They are 3 to 7 cm long. The veins are inconspicuous and the margin is denticulate. The foliage is dark green, becoming scarlet red in the fall. The leaves fully exposed to the sun are thicker and are generally redder in the fall.

The yellowish-green flowers, in clusters of three per cyme, are inconspicuous.

The fruits, capsules, are pink to red and composed of four rounded lobes. They remain on the plant for a very long time. The seeds, arils, are orange. They are toxic and the effects produced after ingestion are similar to those of *Digitalis*.

ORIGIN AND DISTRIBUTION

This cultivar was marketed in 1926 by J.W. Adams, a nursery grower in Massachusetts.

USE

Ornamental: This cultivar is mainly used standing alone in planting beds for the fall colours of its foliage. It is also used to make low hedges.

Floristry: The squared and corky stems are used in floral arrangements.

REQUIREMENTS

This cultivar tolerates moist soils as long as they are well-drained. It adapts to several pH levels and is often found on limestone soils. It prefers a sunny exposure but grows well in semi-shady locations. It is easily transplanted by the root ball method or in pots.

It grows slowly and requires little pruning.

PATHOLOGY

To our knowledge, this plant does not appear to be particularly affected by any disease.

PROPAGATION

Propagation by cuttings: semi-hard cuttings are normally used to propagate this cultivar.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Hedge collection, Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: Cuttings were taken on June 18, 1984 and immersed in a solution of 4,000 ppm IBA and 50% ethanol. They were placed under mist for an average duration of 30 seconds every seven minutes on a substrate of perlite (100%). The rooting period was four weeks. They were potted on July 12 and placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young plants 5 to 7 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, no damage occurred during the first, third and fifth winters. This cultivar was heavily damaged by rodents the second winter, affecting 81% of the plants. In addition, 17% of the plants died the fourth winter, 17% suffered frost damage on the stem tips and 60% suffered frost damage down to the level of snow cover.

The behaviour of the plants was very similar at the site on clay, apart from the fact that damage by rodents and frost damage on the stem tips occurred during two winters.

At Sainte-Clotilde, all the plants suffered damage caused by rodents during the second, third and fourth winters, resulting in the death of one plant the last year.

Region 2

At Sainte-Foy, 25% and 44% respectively of the plants died during the third and fourth winters. This mortality could be attributed to excessively severe damage caused previously by rodents, since all the plants that died had been severely affected. Mild frost damage on the shoot tips affected 11%, 22% and 40% of the plants during the first and last two winters.

At Deschambault, no damage occurred the second winter. In subsequent years, 42%, 25% and 17% of the plants suffered frost damage on the stem tips. In addition, the previous year's shoot was damaged on 33% of the plants the fourth winter. Mechanical breakage was observed on 42% and 25% of the plants the last two winters.

At La Pocatière, the plants died gradually during the testing period, leaving only two specimens; the pedological conditions of the plot were the main cause of this mortality. The living plants were affected by frost damage every year to varying degrees.

Region 3

At Normandin, no damage was observed the first three winters. The fourth spring, 25% of the plants exhibited frost damage on the stem tips and one plant died.

At Kapuskasing, only one plant died during the second winter and this plant had suffered frost damage down to the ground level the previous year. Frost damage on the stem tips was the most frequently observed damage, affecting 86%, 36%, 91% and 18% of the plants depending on the year.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.70 m R2 = 0.57 m R3 = 0.40 m

Categories

The average height of the shrubs after five years varied from one station to another:

0.81 m and + : Sainte-Clotilde
 0.71 - 0.80 m: L'Assomption on sand
 0.61 - 0.70 m: Deschambault
 0.51 - 0.60 m: Sainte-Foy
 0.41 - 0.50 m: L'Assomption on clay and Normandin
 0.40 m and - : Kapuskasing and La Pocatière

This cultivar does not tolerate heavy and compacted soils and grows more poorly on clay soils; no growth was observed at La Pocatière during the testing period.

Effect of pruning

As a result of damage caused by rodents, the plants at Sainte-Clotilde were cut back by half the last year and those at Sainte-Foy were cut back to the ground the last two years.

Growth in width

After five years, the average width for each region was:

R1 = 0.47 m R2 = 0.63 m R3 = 0.39 m

The data for the La Pocatière site were not included in calculating the average for region 2. The plants in this region were wider than they were high.

***Euonymus alatus* 'Compactus'**

Categories

The average width of the shrubs after five years varied from one station to another:

0.61 - 0.70 m:	Deschambault
0.51 - 0.60 m:	Sainte-Foy and L'Assomption on sand
0.41 - 0.50 m:	Sainte-Clotilde and Kapuskasing
0.31 - 0.40 m:	L'Assomption on clay and Normandin
0.30 m and - :	La Pocatière

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

In general, this plant grew very quickly during the initial years and it is possible to obtain shrubs 25 to 50 cm high during the first two years of growth in regions 1 and 2. Heavy and clay soils are clearly not recommended for this cultivar. Moreover, rodents are particularly attracted to this plant and cause serious damage which can result in the death of the plants.

Use

The zone rating of 3 for this species, assigned by Sherk and Buckley, appears to be consistent with the potential of this cultivar. Indeed, the mortality observed at the La Pocatière site was due to the edaphic conditions of the plot, while the mortality observed at Sainte-Foy was related to damage by rodents. Since the height of the plants did not exceed the level of snow cover at the two sites in zone 2, the results do not enable us to make a definitive evaluation of the hardiness of this cultivar in this zone in open conditions. However, this cultivar is of interest in zone 2 for its fall colours.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 47, 50, 56, 57, 58, 86, 101, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Euonymus alatus* 'Compactus' from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage								Cumulative damage	
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	59	23		4		3			11		41
L'Assomption-sand	66	3		12		3			16		34
Sainte-Clotilde	38					2			60		62
REGION 2											
Deschambault	46	21	8				2	17	6		54
Sainte-Foy	46	15				19			20		54
La Pocatière ^b	13	11	14	6		50			6		87
REGION 3											
Normandin	91	7				2					9
Kapuskasing	45	50		2		1		2			55

- ^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 splitting |
| 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 types 3, 5, 7 and 14 occurred for this species.

^b The total mortality at La Pocatière at the end of the testing period was 100%. All the other types of damage occurred the first year on the plants that survived the first winter.

Table 2: Breakdown of *Euonymus alatus* 'Compactus' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-25	38	0	0	0	0	29	0	0	0	0	84	16	9	0	0										
26-50	62	100	58	17	0	71	95	100	82	88	16	53	83	25	17										
51-75	0	0	42	83	40	0	5	0	18	12	0	26	0	42	17										
76-100	0	0	0	0	60	-	-	-	-	-	0	5	8	33	33										
101-125	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25										
126-150	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	11	0	0	12	0	15	5	0	0	0	62	75	80	67	100	19	14	0	0	9	48	95	9	0	0
26-50	89	83	17	50	60	85	90	25	0	33	38	25	20	33	0	81	86	92	92	73	52	5	91	100	100
51-75	0	17	83	38	40	0	5	75	100	42	-	-	-	-	-	0	0	8	8	18	-	-	-	-	-
76-100	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126-150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Euonymus alatus* 'Compactus' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	5	0	0	0	95	33	0	0	0	100	47	8	0	0
21-40	0	95	75	0	0	5	67	82	36	75	0	53	92	83	17
41-60	0	0	25	67	80	0	0	18	54	25	0	0	0	9	75
61-80	0	0	0	33	20	0	0	0	10	0	0	0	0	8	8
81-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	94	11	0	12	0	95	33	0	0	0	86	100	100	33	100	100	33	0	0	27	90	100	9	0	0
21-40	6	89	0	25	20	5	67	8	8	0	14	0	0	67	0	0	67	92	33	55	10	0	91	82	27
41-60	0	0	83	63	20	0	0	92	59	42	-	-	-	-	-	0	0	8	67	18	0	0	0	18	73
61-80	0	0	17	0	60	0	0	0	33	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81-100	-	-	-	-	-	0	0	0	0	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Euonymus europaeus L.

See colour plate

Family	:	Celastraceae
English name	:	European spindle tree
French name	:	Fusain d'Europe
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This large shrub, with a narrow and erect growth habit when young, subsequently becomes wider. It can attain a height of 2.5 to 5.0 m. It is also cultivated in the form of a small single-stemmed tree. The bark is rather greenish.

The diverging branches are completely glabrous. The angular branches have inconspicuous corky wings.

The buds are green, overlapping and resemble those of the Norway maple. The opposite, simple, oval or lanceolate, acute leaves, which have a finely toothed margin, are 3 to 7 cm long and 1 to 3 cm wide. They are coarse, glabrous and dark green, turning red in the fall. Leafing becomes established rapidly in the spring.

The yellowish-green flowers, in cymes of three to five, have four petals, four stamens and yellow anthers.

The fruits, capsules, are pink to red, composed of four rounded lobes and are 12 to 18 mm in diameter. They remain on the tree a very long time. The seeds, arils, are orange. They are toxic and the effects produced after ingestion are similar to those of *Digitalis*.

ORIGIN AND DISTRIBUTION

This species comes from Europe and western Asia. It is widely planted in Czechoslovakia and Romania and is used to stabilize sand dunes in France. It was introduced to the United States around 1922.

USE

Ornamental: This species is mainly used for its foliage, as a screen or in clumps. Its fall colours are very attractive.

Artistic uses: Its wood is burnt to produce the charcoal used in sketching.

REQUIREMENTS

This species tolerates moist soils if they are well-drained. It adapts to all soil pH levels and is often found on limestone soils. It prefers a sunny exposure but grows well in semi-shady locations. It is easily transplanted, by the root ball method or in a pot.

It is relatively fast-growing.

PATHOLOGY

To our knowledge, this species does not appear to be seriously affected by any disease.

PROPAGATION

Propagation by cuttings: Softwood cuttings take root quickly with proper hormone treatment.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 307 cuttings of approximately 13 cm were taken on July 6, 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator on a substrate composed of peat (40%) and perlite (60%). The rooting rate was 100% after 52 days. Potting was carried out on August 6 and 27 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 15 and/or September 10. The plants overwintered in the open frame under a thick cover of snow and the winter survival rate was 79%; 242 plants were transplanted to the nursery in May 1985 and the recovery rate was 81%. They overwintered in the nursery and the winter survival rate was 100%. They were dug up on May 2, 1986, puddled, wrapped

and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 13 to 16 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Conditions during the fourth winter were particularly harsh at all the sites.

Region 1

No damage was observed at the L'Assomption on sand and Sainte-Clotilde sites.

At the l'Assomption site on clay, damage was observed two winters only: all the plants were affected by field mice during the second winter and all the plants suffered frost damage during the fourth winter.

Region 2

Conditions during the second and fourth winters caused the most damage to the plants at Sainte-Foy and Deschambault. At Sainte-Foy, frost damage on the stem tips occurred three winters out of five, affecting 90%, 50% and 33% of the plants. In addition, 33% of the plants were gnawed down to the ground level by field mice the fourth winter.

At Deschambault, 81% of the plants suffered frost damage on the stem tips the second winter. The fourth winter, 33%, 8% and 58% of the plants respectively were affected by frost damage on the stem tips, on the previous year's shoot or on the old wood.

At La Pocatière, mortality was very high given the poor pedological conditions of the plots where the plants were planted. Few plants survived the testing period. Frost damage was particularly severe the first four years.

Region 3

At Normandin, frost damage on the stem tips occurred during the first two winters and the last winter, affecting respectively 62%, 100% and 33% of the plants. More serious frost damage was observed on all the plants

following the fourth winter: 92% suffered damage on the previous year's shoot and 8% were damaged down to the ground level.

At Kapuskasing, 85% or more of the plants did not suffer any damage four winters out of five. During the fourth winter, 17% of the plants suffered frost damage on the stem tips, 67% suffered frost damage down to the level of snow cover and 16% suffered mechanical breakage due to the weight of the snow.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.42 m R2 = 1.28 m R3 = 1.07 m

The L'Assomption on clay, La Pocatière and Kapuskasing sites brought down their respective regional averages.

Categories

The average height of the shrubs after five years varied from one station to another:

1.71 m and + : Deschambault
 1.51 - 1.70 m: Sainte-Clotilde and L'Assomption on sand
 1.01 - 1.50 m: Sainte-Foy, Normandin and L'Assomption on clay
 1.00 m and - : Kapuskasing

Annual growth was very poor at Sainte-Clotilde during the last year.

Effect of pruning

Annual pruning consisted in eliminating the damaged portions of the stems.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.04 m R2 = 0.98 m R3 = 1.06 m

***Euonymus europaeus* L.**

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.26 - 1.50 m: Deschambault and Sainte-Clotilde
 1.01 - 1.25 m: Sainte-Foy, L'Assomption on sand,
 Normandin and Kapuskasing
 0.76 - 1.00 m: -
 0.75 m and - : L'Assomption on clay and La Pocatière

At the two L'Assomption sites and at Sainte-Foy, the final width of the plants was unchanged between the fourth and the last growing season.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The production of this species is clearly poorer on heavy and poorly drained soils. The growth of the plants was similar in regions 1 and 2, namely climate zones 4 and 5, as well as at Normandin, zone 2b. It is therefore possible to obtain plants more than 50 cm high by the end of the second growing season at several sites.

Although this species is significantly less affected by field mice than *Euonymus alatus* 'Compactus', it is necessary to avoid locations where field mice are likely to be a problem.

Use

In suitable pedological conditions, no damage was observed in zone 5. As well, at the sites zoned 4b, winter damage was occasional and rarely harmful. The annual growth which followed severe pruning did not adversely affect the ornamental appearance of the plant. In zone 2, more severe damage occurred during a single winter. Since the height of the plants at Kapuskasing did not exceed the level of snow cover during the cold period, the results obtained do not enable us to make a

definitive evaluation of the hardiness of this species in zone 2a. The zone rating of 4, established by Sherk and Buckley, appears to be conservative and could be modified to 3 without too much risk.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 26, 27, 50, 56, 57, 86, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Euonymus europaeus* from 1986 to 1991

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	60	13	4						20		40
L'Assomption-sand	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	55	29	2				14				45
Sainte-Foy	57	36							7		43
La Pocatière	26	16	32	12		14					74
REGION 3											
Normandin	41	39	18		2						59
Kapuskasing	78	6		13				3			22

- ^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 splitting |
| 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 types 9 and 14 occurred for this species.

Table 2: Breakdown of *Euonymus europaeus* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-50	95	0	0	0	0	90	33	0	0	0	100	0	0	0	0															
51-100	5	100	83	0	0	10	67	100	100	75	0	100	0	0	0															
101-150	0	0	17	92	42	0	0	0	0	25	0	0	100	92	8															
151-200	0	0	0	8	58	-	-	-	-	-	0	0	0	8	92															
Height (cm)	REGION 2															REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90					
0-50	95	10	0	0	0	95	0	0	0	0	100	100	72	43	29	33	0	0	0	0	100	76	0	0	0					
51-100	5	85	8	0	8	5	80	17	0	0	0	0	28	57	71	67	95	92	8	8	0	24	100	100	67					
101-150	0	5	92	67	58	0	20	83	50	0	-	-	-	-	-	0	5	8	92	92	0	0	0	0	33					
151-200	0	0	0	33	34	0	0	0	50	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					

Table 3: Breakdown of *Euonymus europaeus* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	71	17	0	0	100	100	58	0	0	100	100	0	0	0
51-100	0	29	83	42	33	0	0	42	100	100	0	0	75	17	0
100-150	0	0	0	58	67	-	-	-	-	-	0	0	25	83	100
151 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskaing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	86	0	0	0	100	57	0	0	0	100	100	86	57	29	95	81	0	0	0	100	100	25	0	0
51-100	0	14	100	17	33	0	43	100	33	0	0	0	14	43	71	5	19	100	100	50	0	0	75	100	42
101-150	0	0	0	83	50	0	0	0	67	58	-	-	-	-	-	0	0	0	0	50	0	0	0	0	58
151 and +	0	0	0	0	17	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Forsythia ovata 'Northern Gold'

See colour plate

Family	:	Oleaceae
English name	:	Northern gold forsythia
French name	:	Forsythie 'Northern gold'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub can attain a height of 1.5 m to 2.0 m in Ottawa and Morden and a width of approximately 1.5 m. It has a loose, erect growth habit.

The stems are greyish. The foliage is abundant. The leaves are simple, elongated, pale green and shiny.

The abundant golden yellow flowers appear very early in the spring, before leafing. This is one of the first shrubs to flower, at the same time as *Ribes sanguineum*. The solitary flowers are about 4.1 cm in diameter and have a corolla tube 2.3 cm long. The flower buds of this cultivar are more cold resistant than those of several other cultivars.

ORIGIN AND DISTRIBUTION

This cultivar was selected in Ottawa by Dr. Sampson in 1965 and was marketed in 1979. It is the result of a cross between *Forsythia ovata* 'Ottawa' and *F. europaea*.

USE

Ornamental: This cultivar can be used alone or in clumps for its spectacular spring flowering.

REQUIREMENTS

It is not very demanding in terms of soil type, but prefers a sunny exposure with sufficient space to express its full development.

Pruning for rejuvenation must be done every five years in order to promote growth and flowering.

PATHOLOGY

To our knowledge, this cultivar does not appear to be affected by insects or diseases.

PROPAGATION

Propagation by cuttings: Propagation of this species by cuttings is considered easy.

Layering: The branches in contact with the ground take root easily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 395 cuttings of approximately 17 cm were taken on July 13, 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were then immersed in a fungicidal solution containing Benomyl-Captan®. They were placed in a mist propagator on a substrate composed of peat (40%) and perlite (60%). The rooting rate was 100% after 45 days. The plants were potted on August 10 and 27 in Fertal Pots® in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 20 and September 10. The plants overwintered in the frame under a thick cover of snow and the winter survival rate was 66%; 260 plants were transplanted to the nursery in May 1985. They were dug up on April 28, puddled, wrapped and placed in a cold store at 4°C until they were shipped on May 7 and 9.

Inclusion in test network: Young plants 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, frost damage occurred during the first winter only; 34% of the plants were affected on the shoot tip and 5% on the old wood.

No damage occurred at the L'Assomption site on clay.

At the Sainte-Clotilde site, 67% of the plants exhibited frost damage on the shoot tip following the third winter. The plants suffered no other damage.

Region 2

Frost damage on the stem tips occurred four winters out of five at the Sainte-Foy site, affecting 10% to 40% of the plants, depending on the year.

However, at Deschambault, the plants were affected by mechanical breakage caused by snowfall; 10% to 75% of the plants exhibited signs of breakage during the first winter and the last two winters. As well, all the plants suffered frost damage on the flower buds during the third winter.

At La Pocatière, 32% of the plants suffered frost damage on the year's shoot the first winter and all these plants died the following winter. The plot's unfavourable pedological conditions resulted in poor establishment of the plants. Only five plants survived and they exhibited little or no damage.

Region 3

At Normandin, 70% to 100% of the plants suffered frost damage on the shoot tips four winters out of five.

At Kapuskasing, all the plants in the first replication (33% of the plants tested) died during the third winter and another died the following winter. In addition, frost damage on the shoot tip affected 33% to 88% of the plants the first four winters. No damage occurred the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.66 m R2 = 1.62 m R3 = 1.42 m

The plants on the clay sites brought down their regional average.

Categories

The average height of the shrubs varied from one station to another:

2.01 m and + : Deschambault
 1.76 - 2.00 m: L'Assomption on sand
 1.51 - 1.75 m: Sainte-Clotilde, Sainte-Foy and L'Assomption on clay
 1.50 m and - : Kapuskasing, Normandin and La Pocatière

Effect of pruning

There was generally little pruning of this species the first three years. Thereafter, the shoots were pruned by between 15% and 30%, depending on the site.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.28 m R2 = 1.40 m R3 = 1.13 m

Categories

The average width of the shrubs after five years varied from one station to another:

1.26 - 1.50 m: Deschambault, La Pocatière, Sainte-Foy, L'Assomption on sand and Sainte-Clotilde
 1.01 - 1.25 m: L'Assomption on clay, Normandin and Kapuskasing

Growth was poorer on clay soils.

Forsythia ovata 'Northern Gold'....

Flowering

Flowering occurred regularly at the three sites in the Montreal region as well as at Sainte-Foy and Deschambault. At the other sites, flowering was observed two or three times during the last four years of testing.

The flowering period began the last week of April throughout the testing period at the L'Assomption sites; at Sainte-Clotilde, the start of the flowering period was somewhat more variable, depending on the spring.

In the Quebec City region, at Normandin and at Kapuskasing, the flowers appeared seven to 15 days later. The duration of flowering varied from 17 to 25 days at all the sites except Kapuskasing, where it was shorter. Full flowering occurred five to ten days after the start of anthesis.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This species grew rapidly at all the sites except Kapuskasing. Indeed, all the plants had attained a height of more than 50 or 100 cm after two years of growth. This species attained its full development during the five years of testing.

Use

This cultivar, obtained by the Agriculture and Agri-Food Canada researchers, had performed very well in a number of Canadian regions, including Ottawa and Morden, but had not been assigned a hardiness rating. The test results showed that this cultivar is not very resistant to the harsh conditions of zone 2a.

However, in zone 2b, the plants were affected only by slight frost damage and flowered normally. This cultivar can be used as far north as 2b in favourable pedological

conditions, in the knowledge that the late frosts encountered in this zone may affect the quality and duration of flowering.

Pruning, if necessary, must be carried out immediately after flowering, since induction of the flower buds occurs in June, as is the case with lilacs.

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4, 56, 86, 97

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Raynald Drapeau, Agr.

Table 1: Frequency of winter damage observed on *Forsythia ovata* 'Northern Gold' from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	3	4	6	7	8	5 and 9	10	11	14	
REGION 1												
L'Assomption-clay	100											0
L'Assomption-sand	92	7						1				8
Sainte-Clotilde	87	13										13
REGION 2												
Deschambault	65		25						10			35
Sainte-Foy	75	25										25
La Pocatière	74	12					14 ^b					26
REGION 3												
Normandin	30	70										70
Kapuskasing	44	45					9	2				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 splitting |
| 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 types 4, 6, 7, 9, 11 and 14 occurred for this species.

^b This five-year average represents 50% of the mortality the first two winters and 17% thereafter. The rest of the data are valid for five plants only.

Table 2: Breakdown of *Forsythia ovata* 'Northern Gold' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-50	38	0	0	0	0	48	0	0	0	0	76	0	0	0	0															
51-100	62	43	0	0	0	52	100	58	0	0	24	9	0	0	0															
101-150	0	57	100	42	25	0	0	42	100	45	0	91	25	25	25															
151-200	0	0	0	58	58	0	0	0	0	55	0	0	75	67	75															
201-250	0	0	0	0	17	-	-	-	-	-	0	0	0	8	0															
Height (cm)	REGION 2															REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90					
0-50	14	0	0	0	0	67	0	0	0	0	100	30	17	20	0	5	0	0	0	0	100	86	11	0	0					
51-100	86	5	0	0	0	33	14	8	0	0	0	70	83	0	20	95	5	8	8	0	0	14	56	50	0					
101-150	0	95	42	50	41	0	86	42	8	0	0	0	80	80	0	95	75	75	66	0	0	33	50	86						
151-200	0	0	58	50	59	0	0	50	75	33	-	-	-	-	0	0	17	17	34	0	0	0	0	14						
201-250	-	-	-	-	-	0	0	0	17	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-						

Table 3: Breakdown of *Forsythia ovata* 'Northern Gold' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	81	0	0	0	0	43	5	0	0	0	57	0	0	0	0
51-100	19	71	92	8	0	57	95	75	33	25	43	100	0	0	0
101-150	0	29	8	84	92	0	0	25	67	67	0	0	100	100	92
151-200	0	0	0	8	8	0	0	0	0	8	0	0	0	0	8
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	81	0	0	0	0	90	0	0	0	0	100	80	17	20	20	62	0	0	0	0	100	42	11	0	0
51-100	19	67	50	17	0	10	100	58	42	0	0	20	83	0	0	38	72	58	25	17	0	58	89	37	43
101-150	0	33	50	83	58	0	0	42	58	83	0	0	0	80	80	0	28	25	75	83	0	0	0	63	57
151-200	0	0	0	0	33	0	0	0	0	17	-	-	-	-	-	0	0	17	0	0	-	-	-	-	-
201-250	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Hippophae rhamnoides L.

See colour plate

Family	:	Eleagnaceae
English name	:	Sallow-thorn, sea-buckthorn
French name	:	Argousier faux-nerprun
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This suckering shrub or shrubby tree, with an erect growth habit, can attain a height of 3 m when grown as a shrub and 4.5 to 6 m when grown as a tree. The trunks are crooked and irregular.

It is remarkable for the silvery colour of its young branches and for its dense foliage. The branches are thorny.

The deciduous leaves are narrow, linear, lanceolate, and up to 5 to 7 cm long.

The small, insignificant yellowish flowers appear before the leaves, in early spring.

This species is dioecious. The orange-yellow oval or rounded berries are 6 to 8 mm long and are abundantly distributed along the branches of the female plants. They remain on the plant for part of the winter.

ORIGIN AND DISTRIBUTION

Originating in northern Europe, the sallow-thorn was discovered in 1647. It is found in the temperate regions of Asia, in Europe, and even in the British Isles. It was introduced to North America in 1944.

USE

Ornamental: The thorny branches make its use undesirable in small gardens or near homes.

Naturalization: Its ability to adapt to almost all sites as well as its magnificent foliage and fruits make it a very promising plant for use along highways as well as on the

shores of lakes and bodies of salt water. In Holland, it is used to stabilize dunes.

Food uses: It has been cultivated for centuries, but more frequently since 1940 for its vitamin-rich fruits. Birds do not like the fruits since they are too acidic.

REQUIREMENTS

This species adapts to all soil types. It tolerates sea salt and winds.

To obtain berries, plants with male flowers and plants with female flowers must be grouped together. One male plant is sufficient to pollinate five or six female plants.

PATHOLOGY

To our knowledge, no disease affects this species.

PROPAGATION

Seedlings: The sallow-thorn can be propagated by seeds, but if male or female plants are desired, it is preferable to proceed by layering.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: United States

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

Propagation technique: The seeds were sown in a greenhouse on June 1, 1983, after having soaked in water for two weeks. After emergence, the seedlings were transferred to individual cells, then placed outside until the fall. On June 6, 1984, they were transplanted to the nursery and in the spring of 1985, they were dug up, wrapped and placed in a cold store until they were shipped in May.

Inclusion in test network: Young seedlings 12 to 19 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

The winter damage for this species was minimal, except at Kapuskasing.

Mortality occurred only at the two sites in region 3.

Region 1

No damage occurred at Sainte-Clotilde or at L'Assomption on sand during the entire test period.

At L'Assomption on clay, 67% of the seedlings suffered frost damage on the stem tips the last year only. At Sainte-Anne-de-Bellevue, 30% of the seedlings suffered damage caused by rodents the first year, and 30% to 100% of the seedlings were affected by mild frost damage the last four years.

Region 2

At La Pocatière, all the seedlings suffered frost damage on the stem tips the last four years.

At Deschambault, more severe damage occurred the last winter, such as frost damage on the old wood and frost damage down to the ground level.

At Sainte-Foy, damage was light and occurred particularly the first two winters and the last winter.

Region 3

No damage affected the seedlings at Normandin four years out of five, and the damage that occurred was limited to frost damage on the tip of the shoots. Mortality was low and scattered: one seedling died the second winter as a result of severe mechanical breakage which occurred the previous year and two others died the fourth winter.

At Kapuskasing, more than a third of the seedlings died during the first winter and several others the following years, leaving only two seedlings for evaluation. Frost damage on the entire previous year's shoot was apparent the first winter and, the following four winters, the living seedlings suffered frost damage on the stem tips and down to the level of snow cover.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 2.66 m R2 = 2.19 m R3 = 1.02 m

The L'Assomption on clay and Kapuskasing sites brought down their respective regional averages.

Categories

The average height of the shrubs after five years varied from one site to another:

3.01 - 3.50 m: Sainte-Clotilde
 2.51 - 3.00 m: L'Assomption on sand and Sainte-Anne-de-Bellevue
 2.01 - 2.50 m: La Pocatière, Deschambault and L'Assomption on clay
 1.51 - 2.00 m: Sainte-Foy
 1.01 - 1.50 m: Normandin
 1.00 m and -: Kapuskasing

Effect of pruning

Very little pruning was necessary on this species other than severe pruning for shaping at the beginning of the second growing season.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.73 m R2 = 1.43 m R3 = 0.84 m

Categories

The average width of the shrubs after five years varied from one site to another:

1.51 - 2.00 m: Sainte-Anne-de-Bellevue, Sainte-Clotilde, L'Assomption on sand and Sainte-Foy
 1.01 - 1.50 m: La Pocatière, L'Assomption on clay and Deschambault
 0.51 - 1.00 m: Normandin and Kapuskasing

Hippophae rhamnoides L.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After two years of growth, 86% to 100% of the shrubs located at L'Assomption on sand, Sainte-Anne-de-Bellevue, Sainte-Clotilde and Deschambault had attained a height ranging from 1.00 to 1.50 m. At all the other sites, except Kapuskasing, a third year was necessary to produce plants of the same size.

This plant can be produced under growing conditions similar to those of the sites in regions 1 and 2. However, it grows more quickly in region 1.

Use

The hardiness limit attained by this species is consistent with the zone rating of 2b assigned by Sherk and Buckley. Damage at Kapuskasing, in zone 2a, was significantly greater than elsewhere, and mortality there was very high and regular.

This plant, often used for naturalization purposes, can occasionally wither rapidly. Furthermore, it exhibits fairly significant individual variability when grown from seeds. However, its ability to adapt to all soil types gives it undeniable advantages.

BIBLIOGRAPHICAL REFERENCES

3, 13, 39, 46, 49, 56, 57, 60, 86, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Hippophae rhamnoides* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	87	13								13	
L'Assomption-sand	99	1								1	
Ste-Anne-de-Bellevue	51	43							6	49	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	77				12		6	5		23	
Sainte-Foy	42	58								58	
La Pocatière	20	80								80	
REGION 3											
Normandin	72	19				4		5		28	
Kapuskasing	11	32	8		14	35				89	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 and 6 occurred for this species.

Table 2: Breakdown of *Hippophae rhamnoides* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	0	0	0	0	0	14	0	0	0	0	10	0	0	0	0	5	0	0	0	0					
51-100	100	14	0	0	0	86	90	0	0	0	90	0	0	0	0	95	14	0	0	0					
101-150	0	86	25	0	0	0	10	75	17	25	0	57	0	0	0	0	86	8	0	0					
151-200	0	0	75	0	0	0	0	25	67	33	0	43	17	0	0	0	0	92	33	0					
201-250	0	0	0	83	8	0	0	0	16	42	0	0	67	50	17	0	0	0	67	42					
251-300	0	0	0	17	50	-	-	-	-	-	0	0	16	33	42	0	0	0	0	58					
301-350	0	0	0	0	42	-	-	-	-	-	0	0	0	17	8	-	-	-	-	-					
351-400	-	-	-	-	-	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	9	0	0	0	0	5	0	0	0	0	100	0	0	0	0	29	15	0	0	0	94	85	40	25	0
51-100	86	62	8	8	0	90	14	0	0	0	0	86	0	0	0	71	80	8	0	30	6	15	40	75	100
101-150	5	38	75	50	17	5	76	58	8	8	0	14	58	0	0	0	5	67	33	50	0	0	20	0	0
151-200	0	0	17	25	58	0	10	42	50	17	0	0	42	36	10	0	0	25	67	20	-	-	-	-	-
201-250	0	0	0	17	8	0	0	0	25	41	0	0	0	64	54	-	-	-	-	-	-	-	-	-	-
251-300	0	0	0	0	17	0	0	0	17	25	0	0	0	0	36	-	-	-	-	-	-	-	-	-	-
301-350	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
351-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Hippophae rhamnoides* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	29	5	0	0	0	67	0	0	0	0	71	0	0	0	0
51-100	100	14	0	0	0	71	95	0	0	0	33	10	33	0	0	29	57	0	0	0
101-150	0	86	92	25	33	0	0	100	100	83	0	86	67	50	25	0	43	58	8	0
151-200	0	0	8	75	34	0	0	0	0	17	0	4	0	50	42	0	0	42	83	67
201-250	0	0	0	0	33	-	-	-	-	-	0	0	0	0	33	0	0	0	9	25
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	28	5	0	0	0	19	0	0	0	0	100	0	0	0	0	86	15	0	10	0	100	92	20	50	0
51-100	5	48	5	0	0	76	55	9	0	0	0	100	33	0	0	14	9	42	36	70	0	8	80	50	50
101-150	67	47	78	100	50	5	45	91	92	92	0	0	67	9	64	0	76	50	54	30	0	0	0	0	50
151-200	0	0	17	0	50	0	0	0	8	8	0	0	0	91	36	0	0	8	0	0	-	-	-	-	-
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Hydrangea arborescens 'Annabelle'

See colour plate

Family	:	Saxifragaceae
English name	:	Smooth hydrangea
French name	:	Hydrangée 'Annabelle'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub, with a loose and rounded growth habit, can attain a height of 1.20 to 1.50 m.

The stems are greyish, and more erect and more rigid than those of the type species. They start growing again from the ground every year.

The buds, covered with four to six scales, are brownish-green, glabrous, and 0.25 cm in diameter.

The leaves are opposite, simple to elliptic, wide, acuminate, rounded or cordate at the base; they are 8 to 20 cm long. The blade is dull green, coarsely toothed and glabrous on both sides; the veins on the lower surface may be pubescent. The petiole is 2 to 6 cm long.

The flowers are composed of wide corymbs and appear on the year's shoot. They include a majority of sterile flowers and a few fertile flowers. Flowering is very abundant and the inflorescences are very large and rounded. The flowers are pale green during anthesis and become creamy white during the summer. The flowering period lasts approximately three months, that is, until the severe frosts begin. In the fall, on the first cold nights, the inflorescences become brownish.

ORIGIN AND DISTRIBUTION

This cultivar was observed in 1910 growing in the woods by amateurs who brought it home. They brought it to the attention of J.C. McDaniel, a professor at the University of Illinois, who was responsible for its introduction on the horticultural market in 1964. It was selected for the impressive size of its inflorescences.

USE

Ornamental: This cultivar can be used in clumps or standing alone for the quality and duration of its flowering.

REQUIREMENTS

This cultivar is undemanding in terms of soil type but prefers sunny exposures. To obtain large inflorescences, the plants must be cut back close to the ground every year.

PATHOLOGY

To our knowledge, this cultivar does not appear to be affected by insects or diseases.

PROPAGATION

Propagation by cuttings: This propagation technique yields good results for this cultivar.

Suckering: The plants propagate by suckering and spread easily.

PROPAGATION CARRIED OUT BY REPLOQ

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

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The cuttings were taken on June 16, 1984. They were dipped in a solution of 4,000 ppm IBA and 50% ethanol and placed under mist for an average duration of 30 seconds every seven minutes in a substrate of perlite (100%). They were potted on July 7 in Fertil Pots® in a substrate composed of Pro-Mix® (50%), compost (25%) and sand (25%) and placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young plants 30 to 40 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

No plants survived at the La Pocatière and Kapuskasing sites. At the first site, the pedological conditions were the main cause of mortality while, at the second site, the climatic conditions were the cause.

Region 1

The winter damage results were quite similar at the two L'Assomption sites. Frost damage down to the ground level and to the level of snow cover was observed on all the plants from the second winter. At the site on clay, plant mortality was observed following the last three winters. This mortality occurred only at one of the three plots.

At Sainte-Clotilde, one plant died the first winter. Almost all the plants suffered frost damage on the stem tips during the first two winters. Subsequently, all the plants were affected by frost damage on the previous year's shoot and/or down to the level of snow cover. The last winter, no damage occurred.

Region 2

At Sainte-Foy, frost damage on the stem tips occurred on 75% and 100% of the plants the first and last winters. In addition, frost damage down to the level of snow cover or to the ground level as well as damage caused by rodents affected all the plants the second, third and fourth winters.

At Deschambault, 36% to 100% of the plants suffered little or no damage the last four years. Depending on the year, damage from mechanical breakage, rodents and frost down to the level of snow cover occurred, affecting 30% to 50% of the plants.

At La Pocatière, all the plants died during the first two winters.

Region 3

At Normandin, plant mortality was 13%, 15% and 25% during the first two winters and the fourth winter. The second winter, 85% of the plants suffered frost damage on the stem tips. During the other winters, all the plants were affected by frost damage on the previous year's shoot and frost damage down to the level of snow cover or to the ground level.

At Kapuskasing, all the plants died during the first four years.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.65 m R2 = 0.89 m R3 = 0.74 m*

* This average includes only the plants at the Normandin site.

Categories

The average height of the shrubs after five years varied from one station to another:

1.01 m and + : Deschambault
 0.76 - 1.00 m: Sainte-Foy and Sainte-Clotilde
 0.51 - 0.75 m: Normandin, L'Assomption on sand and La Pocatière
 0.50 m and - : L'Assomption on clay

The maximum height attained by these plants varied little after the second year, except at La Pocatière and at Deschambault, where it increased during the five years of testing.

Effect of pruning

The plants were cut back to 20 cm or down to the ground level depending on the year.

Growth in width

After five years, the average width for each region was:

R1 = 0.77 m R2 = 1.06 m R3 = 0.67 m*

* The average includes only the plants at Normandin.

Categories

The average width of the shrubs after five years varied from one station to another:

1.01 m and + : Deschambault and Sainte-Foy
 0.76 - 1.00 m: Sainte-Clotilde and L'Assomption on sand
 0.51 - 0.75 m: Normandin
 0.50 m and - : La Pocatière and L'Assomption on clay

Hydrangea arborescens
'Annabelle'

The final annual width of the plants varied little after the third year, with growth being similar from one year to the next.

Flowering

At Sainte-Clotilde, the first flowers appeared between June 25 and 30 every year. At L'Assomption, the beginning of the flowering period was more variable, falling between June 15 and July 7 for the site on sand and between July 9 and 13 for the site on clay.

In the Quebec City region, the first flowers were observed between July 4 and 17, depending on the years and the sites.

At Normandin, the plants which survived began to flower around July 20.

The inflorescences remained on the plants until the first black frosts in the fall.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

This cultivar is very fast-growing and, by the second year of production, it was marketable at almost all the sites. Its long-term growth is slower on heavy soils and the final height of the plants is always less than that obtained on lighter, well-drained soils.

Use

The zone rating of this cultivar is 3b according to Sherk and Buckley. The test results effectively demonstrated that the survival of this cultivar is not assured in zone 2b when winter conditions are very harsh or when the plants are not sufficiently protected.

However, although the stems were severely damaged by frost at all the sites, the expression of the ornamental potential of this cultivar is at its best when the plants are cut back close to the ground every year.

This cultivar is an example where the survival potential of the whole plant is different from its potential for use.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 47, 50, 56, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Hydrangea arborescens* 'Annabelle' from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	2	25		48	18	7					98
L'Assomption-sand	7	20		66	7						93
Sainte-Clotilde	26	33	13	20		1	7				74
REGION 2											
Deschambault	49	17		8		4		16	6		51
Sainte-Foy	35			20	24	1			20		65
La Pocatière	0					100					100
REGION 3											
Normandin	0	18	66		7	9					100
Kapuskasing	0					100 ^b					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 splitting |
| 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 types 3 and 14 occurred for this species.

^b None of the plants at Kapuskasing survived beyond the fourth winter.

Table 2: Breakdown of *Hydrangea arborescens* 'Annabelle' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	80	5	0	0	0	90	19	50	10	63	56	0	0	8	0										
51-100	20	95	100	67	100	10	81	50	90	37	44	63	100	92	92										
101-150	0	0	0	33	0	-	-	-	-	-	0	37	0	0	8										
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	84	0	0	0	0	76	0	17	0	0	100	100	100	0	0	84	0	0	38	0	100	85	30	0	0
51-100	16	95	100	100	100	24	85	83	55	0	0	0	100	0	16	100	100	62	100	0	15	70	0	0	
101-150	0	5	0	0	0	0	15	0	45	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Juniperus chinensis

'Hetzii'

See colour plate

Family	:	Cupressaceae
English name	:	Hetzii juniper
French name	:	Genévrier de Chine
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This large shrub with a flared growth habit can attain a height of more than 2 m and a width of 5 m in Europe. The rather ascending branches give the plant a wide and erect form.

The juvenile foliage, often present at the base of specimens, consists of needles 8 mm long. They are spreading, alternate or opposite with a green vein and two glaucous stomatal bands on the lower surface. Fine and abundant, they are dull green and give the shrub a feathery appearance. The adult foliage is scale-like. The leaves, in opposite pairs, are pressed against the branch. The outer surface is convex, green with a slightly paler margin and a small dorsal glandular depression. These leaves are 1.5 mm wide.

The round, pea-like cones are on average 1 cm in diameter but are often irregular in size. They contain two to five seeds each. They are glaucous, bluish the first year then brown-black the following year. The male strobili are bright yellow, very numerous and pollinization takes place in early spring.

ORIGIN AND DISTRIBUTION

This cultivar was developed in the United States by Evergreen Nurseries in 1920.

USE

Ornamental: This cultivar can be used standing alone or in a large planting bed as a ground cover.

Production: This fast-growing cultivar is often used as rootstock for several erect cultivars of the species.

REQUIREMENTS

It grows quickly and requires annual pruning to keep it within a limited area. In general, junipers prefer a sunny exposure as well as rich, deep soil.

Locations that are too exposed to the wind should be avoided.

PATHOLOGY

Juniper rust (*Gymnosporangium* sp.) is a fungal disease that can attack this cultivar but the creeping forms are less susceptible. Phomopsis blight, caused by a fungus (*Phomopsis juniperovora*), results in die-back of the branch tips of junipers. The cultivars or varieties developed from *J. chinensis* are among the most sensitive.

PROPAGATION

Propagation by cuttings: Propagation by hardwood cuttings, taken during the winter, is the most widely used method.

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: 1,000 cuttings of 20 cm were taken on November 26, 1984 from 20-year-old parent plants. They were dipped in a solution of 4,000 ppm IBA and 50% ethanol. They were placed under mist for an average duration of 10 seconds every 5, 6 or 10 minutes depending on the intensity of the sunlight. The substrate was a mix of sand (50%), peat (25%) and perlite (25%). The rooting rate was 50% after five months. In April 1985, the plants were potted in Fertil Pots® in a substrate composed of Pro-Mix® (50%), compost (25%) and sand (25%) and placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young plants 15 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter

survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

The plants in region 1 were significantly less affected than those in the other regions. At the L'Assomption on sand and Sainte-Clotilde sites, no damage was observed during the testing period.

At L'Assomption on clay, two plants were affected the fourth winter on the previous year's shoot and one plant suffered frost damage on the stem tips the third winter.

Region 2

At Sainte-Foy, browning of the foliage was observed on several plants every year and to a greater extent the last two winters. In addition, 25% and 14% of the plants died during the third and fourth winters.

At Deschambault, little damage occurred the first two winters. Subsequently, 64% and 100% of the plants suffered browning of the foliage. One plant died during the second winter.

At La Pocatière, browning of the foliage was observed on 65%, 10%, 50% and 100% of the plants the first four winters respectively. One plant died the second winter and no damage occurred the last winter.

Region 3

At Normandin, annual mortality of 15% to 30% considerably reduced the number of plants in the test. In addition, damage on the entire year's shoot or on the stem tips affected 16% to 70% of the plants every year.

At Kapuskasing, mortality was also very high, eliminating 20% to 50% of the plants every year. The living plants suffered browning of the foliage, frost damage on the old wood or on the trunk and frost damage on the stem tips.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 59 cm R2 = 46 cm R3 = 38 cm

The height of the plants at the Sainte-Clotilde site was clearly greater in region 1 and the height of the plants at Sainte-Foy clearly lower in region 2.

Categories

The average height of the shrubs after five years varied from one station to another:

71 cm and + : Sainte-Clotilde
61 - 70 cm : -
51 - 60 cm : L'Assomption on sand and Deschambault
41 - 50 cm : La Pocatière and L'Assomption on clay
31 - 40 cm : Sainte-Foy, Normandin and Kapuskasing

Effect of pruning

Pruning was necessary to eliminate the foliage damaged by browning and to balance the shape of the plant.

Growth in width

After five years, the average width for each region was:

R1 = 121 cm R2 = 116 cm R3 = 85 cm

The width of the plants at Sainte-Clotilde was clearly greater than at the other sites. The plants at Deschambault were much less wide than those at the other sites in region 2.

Categories

The average width of the shrubs after five years varied from one station to another:

136 cm and + : Sainte-Clotilde and La Pocatière
121 - 135 cm: Sainte-Foy
106 - 120 cm: L'Assomption on sand
91 - 105 cm: L'Assomption on clay and Normandin
76 - 90 cm: Deschambault and Kapuskasing

Juniperus chinensis* 'Hetzii'...*RECOMMENDATIONS**

Table 2 indicates the percentage of marketable plants by category at each test site for the final width obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined width.

Production

After two years of growth, more than 90% of the plants in region 1 were between 50 and 100 cm wide. This percentage was 80% at the Sainte-Foy site, but the appearance of the plants there was much less attractive.

In region 2, this cultivar was severely damaged by browning of the foliage caused by sunscald or winter dehydration which considerably reduced the production potential.

Use

The test results confirm the hardiness and ornamental potential of this cultivar for zone 5, which corresponds to the zone rating assigned by Buckley. Indeed, although the survival rate of the plants was quite high in zone 4 and although mortality occurred only occasionally, the damage to the foliage of the plants was such that the ornamental appearance was disappointing.

BIBLIOGRAPHICAL REFERENCES

4, 14, 23, 27, 44, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Juniperus chinensis* 'Hetzii' from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	94	2	4								6
L'Assomption-sand	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	31					1		2		66	69
Sainte-Foy	23	2	1			8			3	63	77
La Pocatière	57					1				42	43
REGION 3											
Normandin	36	23	17			22		2			64
Kapuskasing	23	18	3			20	14			22	77

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 6, 7 and 9 occurred for this species.

Table 2: Breakdown of *Juniperus chinensis* 'Hetzii' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-50	100	5	0	0	0	100	10	42	0	9	100	0	0	0	0															
51-100	0	95	50	0	42	0	90	58	73	36	0	100	0	0	0															
101-150	0	0	50	100	50	0	0	0	27	55	0	0	100	25	42															
151-200	0	0	0	0	8	-	-	-	-	-	0	0	0	75	58															
Width (cm)	REGION 2										REGION 3																			
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	19	0	12	0	85	60	27	9	0	100	80	25	8	0	100	72	22	33	40	100	75	43	17	20					
51-100	0	81	33	13	29	15	40	73	64	73	0	20	67	25	17	0	28	78	50	20	0	25	43	83	40					
101-150	0	0	58	50	71	0	0	0	27	27	0	0	8	58	67	0	0	0	17	20	0	0	14	0	40					
151-200	0	0	9	25	0	-	-	-	-	-	0	0	0	9	16	0	0	0	0	20	-	-	-	-	-					

Juniperus conferta Parl.

See colour plate

Family	:	Cupressaceae
English name	:	Shore juniper
French name	:	Genévrier du littoral
Synonym	:	<i>Juniperus littoralis</i> Maxim.
Category	:	Evergreen plant
Subdivision	:	Shrub

PATHOLOGY

To our knowledge, no particular disease appears to affect this species.

PROPAGATION

Seedlings: This species can be propagated by seeds but propagation by cuttings is the best and fastest method.

Propagation by cuttings: Semi-hard cuttings yield good results with a rooting hormone.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Rosarium at the Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: Cuttings of 25 cm were taken on October 10, 1982 and treated with Seradix No. 3. They were placed in a greenhouse on a substrate of perlite under mist for an average frequency of one minute an hour. The plants were potted on March 20, 1983 and cultivated in a frame. On June 6, 1984, they were transplanted and cultivated in the nursery. In May 1985, the plants were dug up, wrapped and placed in a cold store until they were shipped a few days later. The winter survival rate was 98%.

Inclusion in test network: Young plants 19 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

No plants survived in region 3. Damage was more severe following the first winter.

Region 1

At Sainte-Clotilde, more than 90% of the plants were not affected by winter damage. A few plants died following the first three winters.

At Sainte-Anne-de-Bellevue, 58% of the plants suffered damage following the first winter: 21% died and 37%

BOTANICAL DESCRIPTION

This coniferous shrub, with a prostrate and widespreading growth habit, can reach a maximum height of 30 cm. With time, it forms a mat which can grow to 1.80 to 2.50 m in diameter (15 to 20 years).

The bark is brown. The short branches are ascending. The foliage is vivid green. On the young shoots, the leaves are pressed against the branch and allow only the apple green outer surface to be seen. In the second year, the needles, which are 10 to 15 mm long, are more open and allow the white colours of the inner surface to be seen.

The decorative fruits are abundant, 8 to 12 mm in diameter and change from red to dark purple when ripe.

ORIGIN AND DISTRIBUTION

This species is of Japanese origin and is found mainly on sand in coastal areas.

USE

Ornamental: This species is used for planting borders and rock gardens. Because of its origin, it can be placed in gardens on the seashore.

REQUIREMENTS

This species prefers dry, sandy soils and sunny exposures. It tolerates sea salt quite well.

suffered frost damage on the stem tips. No other damage was observed the following winters.

At L'Assomption on sand, all the plants suffered damage following the first winter: 60% exhibited frost damage on the stem tips, 35% suffered frost damage on the old wood and 5% died. No other damage occurred subsequently, with the exception of sunscald on 58% of the plants during the fourth winter.

At L'Assomption on clay, damage was serious three years out of five; 15%, 9% and 18% of the plants died following the first winter and the last two winters respectively. Frost damage on the stem tips was observed four winters out of five on 10% to 70% of the plants and 40% of the plants exhibited frost damage on the old wood the first winter.

Region 2

At Sainte-Foy, damage from browning of the foliage was observed the last four winters. Only one plant died the last winter.

At Deschambault, 62% of the plants died on transplanting¹ and 25% following the first winter. The five plants that survived suffered damage from browning of the foliage the last two winters.

At La Pocatière, 72% of the plants died on transplanting* and 17% following the first winter; five plants survived and half of these suffered damage from browning of the foliage two winters out of four.

Region 3

At Normandin, 30% of the plants died on transplanting*. Furthermore, mortality was gradual over the years and all the plants had died by the end of the fourth winter.

At Kapuskasing, 90% of the plants died after the first winter and the others the following winter.

* At the other sites, mortality on transplanting was less than 8%.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.24 m R2 = 0.24 m R3 = -

The plants had all attained a similar height.

Categories

The average height of the shrubs after five years showed little variation from one site to another:

0.26 - 0.30 m: Sainte-Clotilde, Sainte-Anne-de-Bellevue and Deschambault
0.21 - 0.25 m: Sainte-Foy, L'Assomption on sand, L'Assomption on clay and La Pocatière

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.12 m R2 = 1.25 m R3 = -

The two sites at L'Assomption brought down the regional average.

Categories

The average width of the shrubs after five years varied from one site to another:

1.51 - 2.00 m: Sainte-Anne-de-Bellevue
1.01 - 1.50 m: Sainte-Foy, Sainte-Clotilde, Deschambault and La Pocatière
0.51 - 1.00 m: L'Assomption on sand
0.50 m and - : L'Assomption on clay

The plants in each category were clearly different from each other.

Effect of pruning

Pruning for shaping was carried out in the initial years.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final width obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined width.

Juniperus conferta* Parl.*Production**

After two years of growth, 73% and 90% of the plants at Sainte-Foy and Sainte-Anne-de-Bellevue had attained a width of between 0.51 and 1.00 m.

A third year was necessary at Sainte-Clotilde and Deschambault to obtain a similar production.

These sites represent the locations where production of this species is recommended.

Regeneration of growth after transplanting was poor at three of the nine sites. Frequent watering appears to be necessary for regeneration of growth the first year.

Use

This species was not zoned by Sherk and Buckley. However, several American studies classify it in zone 5, which generally corresponds to Canadian zone 6.

The test results show that this species grows very well in zone 5b and exhibits relatively little serious damage in zone 4.

Consequently, a zone rating of 5b would appear to more accurately reflect the survival potential of this plant without special protection. In zones 5a and 4b, this prostrate species would probably benefit from the heavy snow cover in these regions, thereby increasing the extent of its potential for use in Quebec.

BIBLIOGRAPHICAL REFERENCES

3, 14, 22, 44, 47, 60, 100

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Raynald Drapeau, Agr.

Table 1: Frequency of winter damage observed on *Juniperus conferta* from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	49	28		2		9	8			4	51
L'Assomption-sand	68	12				1	19				32
Ste-Anne-de-Bellevue	88	7				5					12
Sainte-Clotilde	94		1			5					6
REGION 2											
Deschambault	33	10				7				50	67
Sainte-Foy	32	1				2				65	68
La Pocatière	63	7	3			3	6			18	37
REGION 3											
Normandin ^b	5	45	7			43					95
Kapuskasing ^c	2					98					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 splitting |
| 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 types 3, 7, 10 and 11 occurred for this species.

^b All the plants died by the end of the fourth winter.

^c All the plants died by the end of the second winter.

Table 2: Breakdown of *Juniperus conferta* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	100	100	42	25	0	100	100	63	100	78	100	78	0	0	0	100	27	0	0	0					
51-100	0	0	58	75	100	0	0	37	0	22	0	22	83	0	0	0	73	37	64	0					
101-150	-	-	-	-	-	-	-	-	-	-	0	0	17	100	100	0	0	63	36	18					
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	82					
Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	10	0	0	0	100	67	20	20	0	100	80	60	0	0	100	89	0	0	0	100	0	0	0	0
51-100	0	90	92	67	0	0	33	80	80	20	0	20	40	100	20	0	11	0	0	0	-	-	-	-	-
101-150	0	0	8	33	72	0	0	0	0	60	0	0	0	0	80	-	-	-	-	-	-	-	-	-	-
151-200	0	0	0	0	28	0	0	0	0	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Juniperus sabina L. (C)

See colour plate

Family	:	Cupressaceae
English name	:	Savin juniper
French name	:	Sabinier, genévrier sabine
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This coniferous shrub, with a flared growth habit, can attain a height of 0.70 m and a width of 2 m. It has no apparent trunk and is composed of several ascending oblique branches which curve gracefully at the tips.

The texture of the foliage is light and a little denser at the tips. In the adult state, the dark blue-green foliage is scale-like and predominates over the needle-like foliage. The scale-like, opposite, overlapping leaves are 1 to 3 mm long and are found on vigorous branches and the older parts. The needle-like leaves, approximately 4 mm long, have a glaucous inner surface, a greyish-green outer surface and are glandular. The foliage, when crushed, gives off a strong odour.

The ovoid, irregular, pruinose fruits, 5 to 7 mm long, are blue-black and ripen in one or two years with one to three seeds per fruit.

ORIGIN AND DISTRIBUTION

This species originates in southern Europe and is found in various forms which, in its country of origin, can attain a height of 0.30 m to 6.0 m. It is very common in the mountains of Europe above 1,400 m, as well as in southern Russia, in Asia and occasionally in Algeria. In high mountains, it takes on a mat-forming growth habit.

USE

Ornamental: It is used standing alone or in clumps.

REQUIREMENTS

This species prefers dry and limestone soils. It tends to become bare at the base as the plant grows older. In the winter, some desiccation of the foliage is occasionally observed.

PATHOLOGY

When planted in moist soil, this species is sensitive to rust. It can also be attacked by phomopsis blight (*Phomopsis juniperovora*), which causes withering of juniper plants.

PROPAGATION

Seedlings: The galbuli (female cones) must be gathered in the fall as soon as they mature. To improve germination, the seeds can be extracted and treated with sulphuric acid for 30 minutes before being stratified for four months at 5°C.

As an alternative treatment to sulphuric acid, a waiting period of two to three months at room temperature before seeding is reportedly effective.

Propagation by cuttings: This species propagates very well by hardwood cuttings. The rooting rate can be as high as 100%. Minimal hormone treatment of 100 ppm of IBA and additional light for 12 hours a day appear to enhance rooting.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

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

Propagation technique: Cuttings of 15 cm were taken on December 17, 1984 and treated with a hormone solution of 5,000 ppm IBA. They were placed in a greenhouse in a substrate composed of equal parts perlite and peat, then placed in a mist propagator. The temperature of the heating cables was adjusted to 21°C. The rooting rate was 50% after six weeks. The plants were potted on January 29, 1985 and cultivated in a greenhouse until they were shipped in May.

Inclusion in test network: Young plants 10 to 15 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Very little damage or mortality occurred for this species.

Region 1

No damage occurred at the Sainte-Clotilde or Sainte-Anne-de-Bellevue sites.

At the L'Assomption site on clay, two plants died, the first following the first winter and the second the following winter. No other damage affected the plants. At the L'Assomption site on sand, one plant died following the second winter and two other plants suffered sunscald damage the fourth winter.

Region 2

At Deschambault, two plants died following the first winter, another the following winter and a last one following the fourth winter. Damage caused by the weight of the snow affected 17% and 10% of the plants the other two winters.

At Sainte-Foy, the only damage observed was browning of the foliage, affecting less than 10% of the plants the second and third winters, and 100% and 42% of the plants the fourth and last winters.

At La Pocatière, less than 30% of the plants were affected the first two winters: the first winter, 15% of the plants suffered frost damage on the previous year's shoot and 10% of the plants died. The following winter, 30% of the plants suffered browning of the tips or of all the foliage.

Region 3

The percentage of undamaged plants ranged from 80% to 100% at Kapuskasing. One plant died following the first winter and a few plants suffered various kinds of damage very occasionally.

At Normandin, only one plant showed signs of frost damage on the previous year's shoot following the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.55 m R2 = 0.48 m R3 = 0.48 m

The two L'Assomption sites brought down the regional average for region 1.

Categories

The average height of the shrubs after five years varied from one site to another:

0.61 - 0.70 m: Sainte-Clotilde and Sainte-Anne-de-Bellevue
 0.51 - 0.60 m: Normandin
 0.41 - 0.50 m: Sainte-Foy, Deschambault, La Pocatière, L'Assomption on sand and Kapuskasing
 0.31 - 0.40 m: L'Assomption on clay

The plants at Sainte-Clotilde and Sainte-Anne-de-Bellevue were clearly higher than those at the other sites.

No growth was observed at L'Assomption and at Kapuskasing the last year.

Effect of pruning

Only light pruning for shaping was necessary at the beginning of testing.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.30 m R2 = 1.26 m R3 = 1.00 m

The two L'Assomption sites substantially lowered the regional average for region 1.

Juniperus sabina L. (C)

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.76 m and +: Sainte-Anne-de-Bellevue
- 1.51 - 1.75 m: Sainte-Clotilde
- 1.26 - 1.50 m: La Pocatière
- 1.01 - 1.25 m: Deschambault, Sainte-Foy,
L'Assomption on sand and
Kapuskasig
- 0.76 - 1.00 m: Normandin and L'Assomption on clay

The shrubs at Sainte-Anne-de-Bellevue were clearly wider than those at all the other sites. In addition, those at Sainte-Clotilde were also very wide.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

Growth was very rapid at the Sainte-Anne-de-Bellevue site and 65% of the shrubs were between 20 and 40 cm high after the first year of growth.

After the second year, 100% of the shrubs at Sainte-Clotilde and Sainte-Anne-de-Bellevue had attained or exceeded this height, with the percentage being 89%, 79%, 76% and 69% at the Sainte-Foy, Deschambault, Normandin and L'Assomption on sand sites. At the other sites, a third year of growth was necessary to obtain a comparable production.

Commercial production of this species is significantly faster in the region south of Montreal since 90% or more of the plants at these sites had attained a width of 41 to 80 cm after two years. This is also possible in region 2 and at Normandin, but an additional year will be necessary to obtain a comparable production.

Use

This species is currently assigned a zone rating of 2 according to Sherk and Buckley. Based on its performance during our testing, this rating can be modified to 2a since damage at Kapuskasing was nil or almost nil. It can be used throughout Quebec without suffering damage¹.

This *Juniperus* must be protected by good snow cover since browning of the foliage can occasionally occur.

¹ Since there was no test site in zone 1, the limit of this species could not be determined.

BIBLIOGRAPHICAL REFERENCES

3, 14, 22, 24, 27, 31, 47, 56, 60, 80, 86, 93, 100

WRITTEN BY

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Table 1: Frequency of winter damage observed on *Juniperus sabina* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	98					2					2
L'Assomption-sand	95					1	4				5
Ste-Anne-de-Bellevue	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	89					5		6			11
Sainte-Foy	69									31	31
La Pocatière	89	5	3			2				1	11
REGION 3											
Normandin	98		2								2
Kapuskasing	93					1	2	2		2	7

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

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

Table 2: Breakdown of *Juniperus sabina* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-20	100	31	0	0	0	100	52	9	0	0	100	0	0	0	0	35	0	0	0	0					
21-40	0	69	82	27	27	0	48	91	82	91	0	100	0	0	0	65	65	8	0	0					
41-60	0	0	18	73	73	0	0	0	18	9	0	0	92	67	0	0	35	92	58	17					
61-80	-	-	-	-	-	-	-	-	-	-	0	0	8	33	100	0	0	0	42	83					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	95	11	0	0	0	100	21	0	0	0	100	44	0	0	0	100	24	0	0	8	100	65	0	0	0
21-40	5	89	92	50	0	0	79	75	92	0	0	56	100	33	0	0	76	50	42	0	0	35	100	42	42
41-60	0	0	8	50	100	0	0	25	8	100	0	0	0	67	100	0	0	50	58	84	0	0	0	58	58
61-80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-

Table 3: Breakdown of *Juniperus sabina* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	100	79	36	0	0	100	100	18	27	9	100	10	0	0	0	100	5	0	0	0
41-80	0	21	27	64	0	0	0	82	73	36	0	90	8	0	0	0	55	8	0	0
81-120	0	0	37	36	88	0	0	0	0	55	0	0	92	58	0	0	40	75	16	0
121-160	0	0	0	0	12	-	-	-	-	-	0	0	0	42	91	0	0	17	84	25
161-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9	0	0	0	0	75

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	100	31	0	0	0	100	84	0	0	0	100	39	0	0	0	100	33	0	0	8	100	70	75	0	0
41-80	0	69	50	25	0	0	16	92	33	0	0	61	67	0	0	0	67	92	8	17	0	30	25	67	0
81-120	0	0	50	75	75	0	0	8	67	42	0	0	33	83	0	0	0	8	92	67	0	0	0	33	92
121-160	0	0	0	0	25	0	0	0	0	58	0	0	0	17	100	0	0	0	0	8	0	0	0	0	8
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Juniperus virginiana L.

See colour plate

Family	:	Cupressaceae
English name	:	Eastern red cedar, red cedar, savin
French name	:	Genévrier de virginie, Cèdre rouge de l'Est
Synonym	:	<i>Sabina virginiana</i> (L.) Ant.
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree with a narrow, regular, pyramidal growth habit can attain a height of 15 to 30 m in the United States. In Quebec, specimens exhibit great diversity depending on the origin of the seeds. This is the most common and widespread juniper in the eastern United States. It is conical when young and becomes broader over time as the branches spread out. Most of the branches remain slightly ascending.

The trunk is fairly strong and the bark is reddish-brown, peeling off in strips.

The tree's branch structure is loose and the framework can be seen quite clearly through the branches. The twigs are frail and not flattened. The winter buds are tiny and scaleless.

The foliage, dull green during the summer, becomes coppery or reddish-brown in winter. The branchlets are very fine and are on average 0.75 mm in diameter. The adult leaves are scale-like and overlapping; on young specimens they are needle-like, widely spaced and thorny. They are opposite, ternate, 5 to 6 mm long, glaucous and concave on the inner surface, green and convex on the outer surface and have a dorsal gland.

Flowering takes place in the spring.

The plants are dioecious. The ovoid cones are approximately 5 mm in diameter. They are smaller, less globular and mature earlier than the cones of *J. chinensis*. The vigorous shoots of the female trees

bear a large number of galbuli, small female cones in the form of fleshy berries, about the size of a pea. The galbuli contain wingless seeds which take one growing season to ripen. Bluish or blackish in colour, they are often pruinose and remain on the tree the whole winter.

The trees begin to produce galbuli at around the age of 10 to 15 years and the most productive period occurs between the ages of 25 and 75 years.

ORIGIN AND DISTRIBUTION

This species indigenous to North America occupies vast areas on dry, rocky slopes and on the limestone hills of the eastern United States and from southeastern Canada (Ontario) as far as eastern Texas. It is found particularly in the Deciduous Forest Region and in certain southern parts of the Great Lakes-St. Lawrence Forest Region. It is also found in New Brunswick.

It was introduced to England in 1664.

USE

Ornamental: This species is used in clumps, as a free hedge or pruned 3 m high. It is also used as a windbreak. In addition, it is used as rootstock for numerous cultivars.

Wood use: The reddish, close-grained, fragrant wood is easy to work. In the United States it used for hydro poles, water conduits and coffins. Pencils and cigar boxes are almost always made with this wood. It is also used to produce cedar chips, fence stakes, chests and various other objects.

Ornithology: The galbuli are highly appreciated by more than 50 species of birds.

Various: The oil from this wood is used for immersion objectives in light microscopy. An oil derived from the leaves is used in perfume-making. The crushed leaves give off an odour of paint or soap. The resinous and sweetish galbuli, which have a distinctive flavour, are used in cooking.

REQUIREMENTS

This tree prefers cool, limestone soils, sunny locations and airy spaces. It tolerates acidic or very calcareous soils as well as shade when it is young.

It tends to lose its leaves at the base and requires protection against prevailing winds during the winter.

It grows quickly and is easily transplanted even by the bare root method.

PATHOLOGY

This species is the host of apple rust and is sensitive to phomopsis blight (*Phomopsis juniperovora*), which causes withering of juniper plants.

PROPAGATION

Seedlings: Seeding is the most appropriate method for this species. There is great variation between seed batches and more than 20% of the seedlings do not match the species standard. In addition, approximately 50% of the seeds produced by a tree are viable. The galbuli do not split or open to release the seeds.

After harvesting, it is preferable to soak the galbuli in water for one or two days and rinse them another day in order to remove the resin accumulated in the water. The seeds can be dried and stored or sown immediately. It is also possible to store the fruits for one year before cleaning them and extracting the seeds. After storage and when the seeds are dormant, they must be stratified before seeding. A period of 70 to 90 days at 4°C seems to improve the germination rate. Temperatures above this level reduce the viability of the seeds. Scarification with sulphuric acid is also an effective treatment for this species. The seeds may emerge over a two-year period and emergence was better on a slightly calcareous substrate.

Propagation by cuttings: This is one of the erect junipers which is most difficult to propagate by cuttings and the results obtained are not encouraging.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Schumacher, United States

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

Propagation technique: The seeds were sown on June 8, 1983 in an outside frame after having undergone stratification for 125 days in moist vermiculite at 5°C. The seedlings were potted in small pots on August 24, 1984 and planted in an outside frame until they were shipped in the spring of 1985.

Inclusion in test network: Young seedlings 12 to 15 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Damage from browning of the foliage was observed at six of the nine sites on several occasions.

Much of the damage occurred during the last three winters.

Region 1

No damage was observed at Sainte-Clotilde during the entire testing period.

At Sainte-Anne-de-Bellevue, two seedlings died following the second and fourth winters. At this site, damage was limited to frost damage on the stem tips following three winters out of five, on 17% to 92% of the seedlings depending on the year.

At the l'Assomption site on sand, two seedlings died: the first following the second winter and the second the following winter. Few seedlings were affected the first three winters. However, almost all the seedlings suffered damage from sunscald and browning of the foliage following the last two winters.

At L'Assomption on clay, mortality was similar to the site on sand. Damage was more severe after the third winter: more than half the seedlings suffered frost damage every winter on the old wood, on the previous year's shoot or on the foliage.

Region 2

At Sainte-Foy, mortality was identical to that at the L'Assomption site on clay; 30% of the seedlings suffered frost damage on the stem tips the second winter. Almost all the seedlings were

Juniperus virginiana L.

seriously affected by browning of the foliage the last three winters.

At Deschambault, mortality was higher and more than a third of the seedlings died following the fourth winter; several of these had suffered severe frost damage the previous year.

Frost damage on the previous year's shoot and down to the ground level was observed following the third winter. All the seedlings were affected by browning of the foliage the last two winters.

At La Pocatière, damage resulting in mortality occurred on 5% to 20% of the seedlings following the second, third and fourth winters. Damage from browning of the foliage occurred on 50%, 45%, 78% and 25% of the seedlings following the last four winters.

Region 3

At Normandin, between 60% and 100% of the seedlings did not suffer any damage every year. 22% of the seedlings suffered frost damage on the stem tips following the second winter and 28% suffered mechanical breakage the last winter; 17% and 30% of the seedlings respectively died the third and fourth winters.

At Kapuskasing, more than 50% of the seedlings died following the first winter and all the seedlings had died after the fourth winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.58 m R2 = 1.02 m R3 = 1.03 m*

The seedlings in region 1 were significantly higher than those in the other regions.

* All the seedlings at Kapuskasing died.

Categories

The average height of the trees after five years varied from one site to another:

1.51 - 1.75 m: Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand
 1.26 - 1.50 m: L'Assomption on clay
 1.01 - 1.25 m: Sainte-Foy, Normandin and La Pocatière
 0.76 - 1.00 m: Deschambault

The seedlings at Sainte-Clotilde and Sainte-Anne-de-Bellevue were clearly higher than those at the other stations the first three years.

Effect of pruning

The amount of pruning carried out depended on the extent of winter damage and was kept to a minimum.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 0.91 m R2 = 0.82 m R3 = 0.69 m

Categories

The average width of the trees after five years varied from one site to another:

1.01 m and +: Sainte-Clotilde, La Pocatière and Sainte-Anne-de-Bellevue
 0.76 - 1.00 m: L'Assomption on sand and Sainte-Foy
 0.51 - 0.75 m: L'Assomption on clay, Normandin and Deschambault

The seedlings at La Pocatière were as high as they were wide. The Sainte-Clotilde, Sainte-Anne-de-Bellevue and La Pocatière sites produced wider trees than at the other sites from the fourth year.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After three years of growth, 80% or more of the trees at the Sainte-Clotilde, Sainte-Anne-de-Bellevue and Sainte-Foy sites had attained a height greater than 80 cm. A

fourth year was necessary at the other sites, but the percentage decreased to 77%, 62% and 56% for the Deschambault, La Pocatière and Normandin sites.

The growth in width of the trees was similar to the growth in height, except at La Pocatière where it was greater.

Use

Sherk and Buckley assigned this species a hardiness rating of 3. However, the test results indicate that it is necessary to specify two rating levels, one related to survival and the other related to the ornamental use potential of this species. Indeed, this species can be rated 2b for survival and 5 for use. All the seedlings died at the Kapuskasing site (2a - 1b) and only the seedlings at the sites in zone 5 exhibited no damage from browning related to frost, sunscald or die-back. This type of damage considerably affected the growth habit and esthetic appearance of the plants, particularly in zone 4.

BIBLIOGRAPHICAL REFERENCES

3, 14, 24, 27, 44, 49, 51, 60, 65, 71, 80, 84, 86, 94, 100, 101, 102

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Table 1: Frequency of winter damage observed on *Juniperus virginiana* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	60	5	11			3	10			11	40
L'Assomption-sand	53	9				3	20			15	47
Ste-Anne-de-Bellevue	67	31				2					33
Sainte-Clotilde	100										0
REGION 2											
Deschambault	24	1	16		4	11		2		42	76
Sainte-Foy	32	6				4				58	68
La Pocatière	47	5	1			7				40	53
REGION 3											
Normandin	79	6				9		6			21
Kapuskasing ^b	10				3	47				40	90

- ^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 splitting |
| 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 types 3, 6 and 11 occurred for this species.

^b All the seedlings died after the fourth winter at Kapuskasing.

Table 2: Breakdown of *Juniperus virginiana* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-40	95	15	10	0	0	100	85	0	11	0	100	0	0	0	0	85	0	0	0	0					
41-80	5	85	54	0	0	0	15	67	11	0	0	95	0	0	0	15	95	8	0	0					
81-120	0	0	36	30	0	0	0	33	78	22	0	5	100	25	0	0	5	84	17	0					
121-160	0	0	0	70	60	0	0	0	0	78	0	0	0	75	17	0	0	8	83	27					
161-180	0	0	0	0	40	-	-	-	-	-	0	0	0	0	83	0	0	0	0	73					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin				Kapusksing					
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	100	5	0	0	0	100	38	0	0	0	100	18	11	0	0	100	48	10	0	0	100	89	17	50	0
41-80	0	95	16	8	0	0	62	50	33	43	0	82	89	38	0	0	52	80	44	14	0	11	83	50	0
81-120	0	0	84	67	50	0	0	50	55	43	0	0	0	62	88	0	0	10	56	86	-	-	-	-	-
121-160	0	0	0	25	50	0	0	0	12	14	0	0	0	0	12	-	-	-	-	-	-	-	-	-	-
161-180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Juniperus virginiana* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	100	35	9	0	0	100	75	0	0	0	100	0	0	0	0	100	0	0	0	0
21-40	0	65	64	0	0	0	25	67	13	0	0	100	0	0	0	0	85	17	0	0
41-60	0	0	27	40	0	0	0	33	63	44	0	0	42	0	0	0	15	74	0	0
61-80	0	0	0	60	50	0	0	0	24	44	0	0	58	42	0	0	0	9	33	9
81 and +	0	0	0	0	50	0	0	0	0	12	0	0	0	58	100	0	0	0	67	91

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	95	0	0	0	0	76	5	0	0	0	100	0	0	0	0	100	21	10	0	0	100	11	0	33	0
21-40	5	85	0	0	0	24	75	10	11	0	0	100	33	0	0	0	74	80	22	0	0	89	50	33	0
41-60	0	15	83	41	20	0	20	70	23	57	0	0	55	13	0	0	5	10	56	14	0	0	50	34	0
61-80	0	0	17	52	60	0	0	10	44	29	0	0	12	25	0	0	0	0	22	86	-	-	-	-	-
81 and +	0	0	0	7	20	0	0	10	22	14	0	0	0	62	100	-	-	-	-	-	-	-	-	-	-

Larix decidua Mill

See colour plate

Family	:	Pinaceae
English name	:	European or common larch
French name	:	Mélèze d'Europe
Synonym	:	<i>Larix europea</i> DC
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This large tree, with a narrow conical growth habit, can attain a height of 25 to 40 m in Europe and in the United States.

The bark is thin and greyish on young individuals. On adult trees, it becomes thick and cracked and grey or brown in colour.

The principal branches are spreading and the secondary branches pendent. The young branches are short, light grey or yellowish and glabrous. They become brownish and annulate as they get older.

The buds are globular, non-resinous and covered with numerous reddish-brown scales. In winter, they are pointed and brown.

The needle-like, alternate, triangular and yellowish-green leaves have two inconspicuous lines of stomata on the lower surface. The length of the needles varies from 15 to 35 mm and they sometimes reach a length of 70 mm on particularly vigorous shoots. They are flexible and soft to the touch. The foliage becomes golden yellow in the fall before the needles fall.

The trees begin to produce cones at around the age of 20. They are monoecious, with male and female cones being found on the same individual. The cones, narrowly conical or cylindrical in shape, are 2 to 5 cm long and 2 cm wide. They appear in the early spring. The male cones are yellow, solitary and fairly large. The female cones are small, erect, red, pink or yellow. They reach maturity in a single growing season. They stand upright on a short peduncle and, when mature,

open to release the seeds. They are composed of 40 to 50 scales.

ORIGIN AND DISTRIBUTION

This species originates mainly in central and northern Europe. Its geographical distribution is quite extensive and is associated mainly with the Alpine mountain chain, with a few isolated stands in the plains. The five geographical races, distributed by altitude, behave differently: for example, a high mountain clone must not be used below 1000 m since it performs poorly on the plain.

In Canada and the United States, the "Polish and Sudeton" races from Czechoslovakia and Romania develop more quickly and are recommended.

USE

Ornamental: This species is used standing alone or in groups for its light green spring foliage and its golden yellow fall foliage.

Wood use: Since the trunk is very straight, the wood is used to make fences used in landscaping.

Forestry: This species is used for reforestation.

REQUIREMENTS

This species is undemanding in terms of soil type, provided that it is fairly deep and cool. It does not tolerate limestone soils or polluted sites.

It is demanding in terms of light and is sensitive to summer droughts.

It can be transplanted quite successfully in the dormant phase.

PATHOLOGY

An insect called the "case-bearer" (*Coleophora laricella*) can be harmful. This insect appears in the early spring and acts like a leaf miner, causing browning of the needles.

PROPAGATION

Seedlings: The cones must be harvested manually in the fall when they become light brown. In general,

abundant cone production occurs at intervals of three to ten years.

The cones must be dried by the sun or in a dryer. The wings must be removed from the seeds mechanically or manually. They can be stored for three years or longer in a dry place, in a sealed container, without loss of viability.

In general, the seeds are sown in the fall or in the spring after a period of stratification and are covered with sand. It is preferable to protect them with mulch the first winter and to remove it before germination.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Lawyer's Nursery, United States

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: The seeds, received on November 16, 1983 were sown in a frame with 63% shade on November 23. On August 3, 1984, the germination rate was 21%. The seedlings were kept in a frame until May 28, 1985, at which time they were transplanted to the nursery; they were approximately 13 cm high. The winter survival rate was 77%. They were dug up on April 4, 1986, wrapped and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Frost damage was generally light. Seedling mortality occurred at the La Pocatière, Normandin and Kapuskasing sites. These three sites are on heavy clay soils but are also located in less favourable climatic zones.

Region 1

No damage was observed at Sainte-Clotilde and 99% of the seedlings at the other two stations were also undamaged.

Region 2

At Sainte-Foy, slight frost damage on the stem tips affected 29% and 56% of the seedlings the first two winters. Thereafter, all the seedlings were undamaged.

At Deschambault, breakage caused by the snow occurred on one seedling during the third and fourth winters.

At La Pocatière, none of the seedlings in replication 2 suffered any damage. However, mortality was particularly high during the first three winters, eliminating almost all the seedlings in replications 1 and 3; water percolation through the soil in these two replications was very poor.

Region 3

At Normandin, two seedlings died the fifth winter. Mild frost damage on the stem tips was observed on 23%, 30% and 10% of the seedlings following the first, third and fourth winters respectively. On average, more than 70% of the seedlings did not suffer any damage during the test.

At Kapuskasing, 25% of the seedlings died during the second winter. The fourth winter was more difficult, resulting in frost damage to the stems above the level of snow cover on 27% of the seedlings, mechanical breakage on 18% of the seedlings and additional mortality.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 4.08 m R2 = 3.28 m R3 = 1.49 m

The sites in region 1 were very homogeneous. Variability between sites was greater in regions 2 and 3.

Annual growth varied from 0.75 m to 1.00 m at the three sites in region 1 and at the two sites in region 2.

***Larix decidua* Mill**

Categories

The average height of the trees after five years varied from one station to another:

- 4.01 - 4.50 m: Sainte-Clotilde, L'Assomption on sand and Sainte-Foy
 3.51 - 4.00 m: Deschambault and L'Assomption on clay
 2.01 - 3.50 m: La Pocatière* and Normandin
 1.01 - 2.00 m: -
 1.00 m and - : Kapuskasing

* At this site, the results would be 3.00 m instead of 2.30 m if we excluded all the seedlings in replications 1 and 2, which were more stunted.

Effect of pruning

Pruning was necessary at Normandin and at Kapuskasing to counter the effects of frost damage.

Growth in width

After five years, the average width of the seedlings for each region was:

R1 = 1.78 m R2 = 1.88 m R3 = 1.20 m

At the sites in region 1, the seedlings were twice as high as they were wide. At the sites in region 2, they were one and a half times higher than they were wide, and, in region 3, they were almost as wide as they were high.

Categories

The average width of the trees after five years varied from one station to another:

- 2.01 m and + : Sainte-Foy and L'Assomption on sand
 1.51 - 2.00 m: Deschambault, Sainte-Clotilde, L'Assomption on clay, La Pocatière and Normandin
 1.01 - 1.50 m: -
 0.51 - 1.00 m: Kapuskasing

The seedlings at Sainte-Clotilde were pruned more severely the last year to permit movement between the rows.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After two years of growth, more than 80% of the trees at L'Assomption on sand, Sainte-Clotilde and Sainte-Foy had attained a height of between 1 and 2 m. The trees at Sainte-Foy were clearly wider. Production at these locations was faster and, particularly, more competitive.

However, after four years of growth, the difference between the sites in regions 1 and 2 decreased, with the exception of the La Pocatière site.

Use

The origin of the race and of the seeds used in the testing is unknown, but their ability to adapt is quite broad. Buckley had assigned this species a zone rating of 3b. The test results indicate that this rating can be identified more precisely as 2b since the damage observed was not very severe. However, it appears important to point out that the soil must be well-drained in order to obtain attractive specimens in the northernmost zones. In addition, the appearance of the tree will be more conical than in the Montreal zone.

In zone 2a, although damage was not very severe, the growth of the tree was significantly slower and the ornamental appearance much less attractive. However, it is able to survive.

BIBLIOGRAPHICAL REFERENCES

4, 12, 18, 24, 40, 45, 47, 68, 80, 96, 97

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Larix decidua* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	99	1									1
L'Assomption-sand	99	1									1
Sainte-Clotilde	100										0
REGION 2											
Deschambault	96							4			4
Sainte-Foy	83	17									17
La Pocatière	81	3	1			15					19
REGION 3											
Normandin	83	13				4					17
Kapuskasing	78	7		5		7		3			22

- ^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 splitting |
| 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 types 3, 5, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Larix decidua* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	100	10	0	0	0	100	57	17	8	0	100	14	0	0	0
101-200	0	90	33	0	0	0	43	67	34	0	0	81	42	0	0
201-300	0	0	58	67	0	0	0	16	50	25	0	5	58	16	0
301-400	0	0	9	17	33	0	0	0	8	58	0	0	0	84	8
401 and +	0	0	0	16	67	0	0	0	0	17	0	0	0	0	92

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	100	14	0	0	0	100	52	0	0	0	100	100	55	44	29	100	82	10	0	0	100	100	91	82	70
101-200	0	86	50	0	0	0	48	100	8	0	0	0	45	14	14	0	18	90	70	50	0	0	9	18	30
201-300	0	0	50	75	8	0	0	0	75	17	0	0	0	42	14	0	0	0	30	30	-	-	-	-	-
301-400	0	0	0	25	42	0	0	0	17	75	0	0	0	0	43	0	0	0	0	20	-	-	-	-	-
401 and +	0	0	0	0	50	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3: Breakdown of *Larix decidua* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	57	0	8	0	0	62	0	8	0	0	14	0	0	0	0
51-100	43	81	25	0	0	38	100	83	17	0	86	67	0	0	0
101-150	0	19	67	17	0	0	0	9	42	42	0	33	67	0	0
150-200	0	0	0	75	67	0	0	0	41	50	0	0	33	100	100
201-250	0	0	0	8	33	0	0	0	0	8	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	62	0	0	0	0	38	NA	0	0	0	86	79	44	0	0	88	0	0	0	0	94	53	45	28	30
51-100	38	38	0	0	0	62	NA	17	0	0	14	21	11	43	29	12	88	10	0	0	6	47	55	45	30
101-150	0	62	58	0	0	0	NA	58	75	8	0	0	45	28	14	0	12	90	50	20	0	0	0	27	30
150-200	0	0	42	75	42	0	NA	25	25	75	0	0	0	29	29	0	0	0	50	80	0	0	0	0	10
201-250	0	0	0	25	58	0	NA	0	0	17	0	0	0	0	28	-	-	-	-	-	-	-	-	-	-

Larix laricina* (Duroi)*K. Koch (C)**

See colour plate

Family	:	Pinaceae
English name	:	Eastern larch, tamarack
French name	:	Mélèze laricin, tamarac
Category	:	Deciduous plant
Synonym	:	Large tree
Subdivision	:	<i>Larix americana</i> Michx

BOTANICAL DESCRIPTION

This large tree, with a narrow conical growth habit, can attain a height of 20 to 30 m and a diameter of 30 to 60 cm. In mixed stands, it has a narrow and less tapered trunk.

The bark is thin and greyish on young individuals and becomes thick and cracked and grey or brown in colour on the adult trees.

The branch structure is light, the branches are short and the branchlets fine. The latter are yellowish and covered with a glaucous bloom.

The buds are small, blackish, shiny and rounded.

The linear, alternate and triangular leaves, light green on the upper surface, are 2 to 3 cm long. They are soft, flexible and turn yellow in late fall.

The small cones, initially red, ovoid, almost cylindrical, from 1.0 to 1.5 cm long, are composed of 15 to 20 scales with a wavy edge but not recurved. They are longer than wide, straight and upright on strong, short, curved stalks.

The roots are shallow but quite spreading, ensuring good wind resistance.

ORIGIN AND DISTRIBUTION

This species is found naturally between the northeastern United States and the Arctic circle. It is often found together with *Picea glauca* and *Picea mariana* on cold acidic peaty soils. In northern regions, it is often

stunted, with a very reduced branch structure, very short needles and fairly narrow cone scales.

USE

Naturalization: This larch is used for reforestation.

Wood use: This species is used to make paper pulp, railroad ties, stakes and crates and in boat building.

REQUIREMENTS

This species is usually found on cold, wet, poorly drained sites; however, it grows better on moist, light, well-drained soils. Since it is shade intolerant, it requires locations with a lot of light and is rarely found in pure stands. Throughout its range, it is found mainly in swamps and sphagnum bogs, mixed with other swampy species.

It grows quickly when young, but much more slowly thereafter.

PATHOLOGY

Around 1874, a sawfly (*Lygaeonematus erichsonii*) almost completely destroyed this species; only the young shoots escaped.

Several fungal diseases attack the foliage of this larch (*Trichoscyphella wilkamii*, *T. ellisiana*, *Aleurodiscus amorphus*, *Leucoctoma kurzei* and *Phomopsis* sp.). In addition, rusts caused by *Melampsora paradoxa*, *M. medusa* and *Melampsorium betulinum* can affect several species of larches and even certain other species.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Berthierville Forest Nursery, Berthier, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: The seeds were received on August 19, 1983 and sown on November 2 at a depth of 10 mm in a substrate composed of Pro-Mix® (33%) and sand (67%) and shaded by a sheet of shading material (63%). The germination rate was 19% in August 1984. The seedlings were cultivated and fertilized in frames until May 1985. They were then transplanted to the nursery and cultivated until the fall, when they were dug up, puddled and heeled in. On April 3, 1986, they were

wrapped, puddled and placed in a cold store at 4°C until they were shipped in May.

Inclusion in test network: Young seedlings 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

No winter damage occurred at the three sites in region 1, other than one seedling that died the second winter at the L'Assomption site on sand. This plant had exhibited no growth during the first year of establishment.

Region 2

At the Sainte-Foy and Deschambault sites, the trees did not suffer any frost damage. Mechanical breakage caused by the weight of the snow occurred on 15% of the seedlings at Sainte-Foy the second winter and frost damage on the stem tips was observed on one seedling the last winter at Deschambault.

At La Pocatière, all the seedlings suffered frost damage down to the level of snow cover during the first winter. No other damage was evident thereafter.

Region 3

At Normandin, 64% of the seedlings suffered frost damage on the stem tips during the first winter and two seedlings died the last winter. No other damage was evident during the testing period.

No damage was observed at Kapuskasing.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.87 m R2 = 2.62 m R3 = 2.18 m

There were no apparent differences between the regions.

Categories

The average height of the trees after five years varied from one station to another:

3.01 - 3.50 m: Sainte-Foy, L'Assomption on sand, Sainte-Clotilde and Deschambault
 2.51 - 3.00 m: Normandin
 2.01 - 2.50 m: L'Assomption on clay
 1.51 - 2.00 m: Kapuskasing and La Pocatière

It is obvious that growth was poorer at the sites on clay soil.

Effect of pruning

Very little pruning was necessary for this species.

Growth in width

After five years, the average width for each region was:

R1 = 1.34 m R2 = 1.62 m R3 = 1.32 m

The trees in region 2 were clearly wider than those at the other stations.

Categories

The average width of the trees after five years varied from one station to another:

1.76 - 2.00 m: Deschambault and Sainte-Foy
 1.51 - 1.75 m: Normandin and L'Assomption on sand
 1.26 - 1.50 m: Sainte-Clotilde*
 1.01 - 1.25 m: La Pocatière, L'Assomption on clay and Kapuskasing

* Average obtained the fourth year since the seedlings were subsequently pruned.

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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Larix laricina* (Duroi) K. Koch*Production**

The type of soil had more effect on the growth of *Larix laricina* than on that of *Larix decidua*. Clay soils clearly had a more unfavourable effect in the case of the eastern larch.

Use

This species is quite hardy in zone 2a. There was no frost damage at this site and the plant survived quite well there.

BIBLIOGRAPHICAL REFERENCES

4, 13, 14, 27, 35, 51, 56, 72, 101

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Larix laricina* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	100										0
L'Assomption-sand	99					1					1
Sainte-Clotilde	100										0
REGION 2											
Deschambault	98	2									2
Sainte-Foy	97							3			3
La Pocatière	79	1		20							21
REGION 3											
Normandin	83	14				3					17
Kapuskasing	100										0

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 4, 5, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Larix laricina* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-100	100	15	0	0	0	100	65	16	8	0	100	43	0	0	0										
101-200	0	85	58	8	0	0	35	84	67	25	0	57	92	0	0										
201-300	0	0	42	92	16	0	0	0	25	67	0	0	8	92	42										
301-400	0	0	0	0	84	0	0	0	0	8	0	0	0	8	58										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	100	5	0	0	0	100	48	0	0	0	100	100	82	45	0	100	74	8	0	0	100	100	67	25	0
101-200	0	95	67	0	0	0	52	92	25	0	0	0	18	55	100	0	26	84	33	8	0	0	33	75	92
201-300	0	0	33	100	0	0	0	8	75	50	-	-	-	-	-	0	0	8	67	84	0	0	0	0	8
301-400	0	0	0	0	100	0	0	0	0	50	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-

Table 3: Breakdown of *Larix laricina* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	10	8	0	0	100	50	67	0	0	100	29	0	0	0
51-100	0	90	83	0	0	0	50	33	75	42	0	71	33	0	25
101-150	0	0	9	100	25	0	0	0	25	58	0	0	67	83	75
151-200	0	0	0	0	75	-	-	-	-	-	0	0	0	17	0
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	5	0	0	0	100	NA	0	0	0	100	95	27	0	0	79	16	0	0	0	100	45	25	8	0
51-100	0	76	17	0	0	0	NA	67	8	0	0	5	73	63	36	21	84	59	17	8	0	55	75	92	50
101-150	0	19	83	67	8	0	NA	33	67	17	0	0	0	37	45	0	0	41	75	8	0	0	0	0	42
151-200	0	0	0	33	75	0	NA	0	25	50	0	0	0	0	19	0	0	0	8	84	0	0	0	0	8
201-250	0	0	0	0	17	0	NA	0	0	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Lonicera involucrata (Richards) Banks

See colour plate

Family	:	Caprifoliaceae
English name	:	Bracted honeysuckle, twinberry
French name	:	Chèvrefeuille involucré
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub, with an erect growth habit and rounded top, can attain a height of 2.20 m and a width of 2.00 m.

The stems are ascending, glabrous, angular and greenish.

The foliage is dense. The leaves are opposite, simple, thin, oblong to lanceolate and acuminate, pubescent when young and glabrous thereafter. They are 5 to 10 cm long and are dark green and glossy on the upper surface.

The buds are surrounded by scales that are as long as the buds.

The flowers, in axillary pairs, are tubular, formed at the end of a long peduncle and are 1.0 to 1.5 cm long. The base of the corolla tube is reddish and the tips of the petals are yellow. The flowers are fragrant and appear from spring until late fall. Two very large red bracts surround each inflorescence; these bracts persist after the fall of the petals and remain on the branches while the fruits are being formed. The stamens are as long as the blade.

The globular fruits are wine red, turning purplish black when ripe.

ORIGIN AND DISTRIBUTION

This species, known since 1824, is indigenous to North America and is found in western North America, from Alaska to Mexico.

It is found in cool, moist and even swampy sites.

USE

Ornamental: This species can be used standing alone or in clumps. The bracts, flowers and fruits may all be present at the same time, further enhancing the attractiveness of the plant.

REQUIREMENTS

It tolerates clay soils, limited spaces and semi-sunny conditions quite well but its growth is then slower.

PATHOLOGY

No particular disease seems to affect this species.

PROPAGATION

Propagation by cuttings: Softwood cuttings yield good results.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: Cuttings of 15 cm were taken on July 1, 1983 and treated with a solution of 4,000 ppm IBA after being dipped in a fungicidal solution of Benomyl-Captan[®]. They were placed in a substrate composed of peat (40%) and perlite (60%), then placed in a mist propagator. The rooting rate was 95% after four weeks. On September 1, the plants were potted and were placed in a frame on September 15. They overwintered in an outside frame under a thick layer of snow and the survival rate was 95%. They were cultivated in the nursery until they were dug up in May 1985. The plants were wrapped and placed in a cold store until they were shipped a few days later.

Inclusion in test network: Young plants 25 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Frost damage was frequent every year at all the sites and the most frequently observed was frost damage down to the level of snow cover and down to the ground level.

Region 1

At L'Assomption on sand, all the plants suffered frost damage down to the snow level four years out of five. At L'Assomption on clay, frost damage down to the level of snow cover was observed following the first three winters and all the plants suffered frost damage down to ground level the other two winters.

At Sainte-Clotilde, a few plants died following the first winter; the plants suffered frost damage on the stem tips the two following winters and they all suffered frost damage on the old wood the last few winters. The severity of damage increased gradually.

At Sainte-Anne-de-Bellevue, only damage to the stem tips was observed over the years.

Region 2

At Sainte-Foy, all the plants suffered damage on the previous year's shoot following the first, third and fourth winters. Damage was less severe the second year and the plants suffered frost damage down to the level of snow cover the last winter.

At Deschambault, all the plants suffered frost damage down to the ground level following the first winter. They suffered damage on the entire previous year's shoot the third and last winters and frost damage on the old wood the fourth winter.

At La Pocatière, the year's shoot was affected on all the plants four years out of five.

Region 3

At Normandin, no damage was observed the first winter, since the plants were protected by the snow. The second and third winters, they suffered frost damage on the stem tips and the last two winters, frost damage was evident on the entire previous year's shoot.

At Kapuskasing, only one plant died following the first winter. Damage ranged from frost damage down to the

ground level, down to the level of snow cover or on the previous year's shoot.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.57 m R2 = 1.63 m R3 = 1.14 m

The maximum average height of the plants at all the sites in regions 1 and 3 was attained by the end of the third season and by the end of the fourth season at Sainte-Foy.

The height of the plants at the Deschambault and La Pocatière sites increased over the years.

Categories

The average height of the shrubs after five years varied from one site to another:

1.76 - 2.00 m: La Pocatière and Sainte-Anne-de-Bellevue
 1.51 - 1.75 m: Sainte-Clotilde, Deschambault and L'Assomption on sand
 1.26 - 1.50 m: Sainte-Foy, L'Assomption on clay and Normandin
 1.01 - 1.25 m: Kapuskasing

The shrubs at Sainte-Clotilde had attained a height of 1.94 m after the third year and those at Sainte-Foy 1.88 m after four years.

Effect of pruning

This species had to be pruned back to the ground after almost every winter because of damage.

The plants at La Pocatière did not require pruning the last year and the height of 1.98 m attained by these plants in the fifth season reflects this.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.54 m R2 = 1.56 m R3 = 1.04 m

The narrowest plants were those in region 3.

***Lonicera involucrata*
(Richards) Banks**

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.76 - 2.00 m: Sainte-Anne-de-Bellevue and La Pocatière
 1.51 - 1.75 m: Sainte-Foy
 1.26 - 1.50 m: Sainte-Clotilde, L'Assomption on sand and L'Assomption on clay
 1.01 - 1.25 m: Deschambault, Normandin and Kapuskasing

Plants at the first three sites were clearly wider and those at the last three were clearly narrower.

Effect of pruning

Winter damage required pruning in excess of 50% of the previous year's shoot.

Flowering

In general, the plants began to flower in early June at the sites in regions 1 and 2; in one exceptional case in region 1 in 1987, the first flowers appeared by mid-May. Continuous flowering lasted until the first serious fall frosts, i.e. a period of 130 to 160 days.

The plants in region 3 began to flower from late June to July 20 depending on the year. The severe pruning carried out on the plants in this region delayed the onset of the flowering period.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

This species grew very quickly at the sites in regions 1 and 2. After three years of growth, most of the test sites

had produced plants that had attained the maximum height.

In general, after two years of growth, 80% and 90% of the plants at Sainte-Foy and Sainte-Anne-de-Bellevue had attained a height of 1.51 to 2.00 m, while 62% of those at L'Assomption on sand and 53% of those at Sainte-Clotilde were comparable. However, it was possible to obtain plants 1 m high or higher by the end of the second growing season at all the sites except Kapuskasing.

The somewhat slower growth at Normandin explains the less severe winter damage the first few winters; the snow provided winter protection above the height attained.

When the winter was particularly mild, the lack of pruning made it possible to increase the final height of the plants, such as those at La Pocatière the last year.

This shrub can therefore be produced competitively in all the zones in Quebec, except zone 2a. However, it requires severe pruning every spring to eliminate the parts damaged by frost. These losses are quickly offset by very strong annual growth.

Use

This species suffered severe damage at almost all the sites except Sainte-Clotilde and Sainte-Anne-de-Bellevue. Since its resistance to winter conditions seems limited to those experienced at these two sites, the results indicate that it should be assigned a zone rating of 5b, which is the complete opposite of the 1 rating assigned by Sherk and Buckley (1972).

However, this statement must be qualified: in zone 2a, although the above-ground portion of the plants was severely affected, the root system resisted the climatic conditions of zone 2. Despite very severe pruning, the vigorous annual growth makes it possible to produce a plant which is interesting for its foliage, its flowering and its fruit production every year. It behaves somewhat like a perennial plant.

In general, growth is slower on heavy soils or in colder climatic conditions.

BIBLIOGRAPHICAL REFERENCES

3, 23, 57, 60, 71, 86, 95

Table 1: Frequency of winter damage observed on *Lonicera involucrata* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	0			60	40					100
L'Assomption-sand	0	20		80						100
Ste-Anne-de-Bellevue	0	100								100
Sainte-Clotilde	18	40	40			2				82
REGION 2										
Deschambault	0		50		25	2	23			100
Sainte-Foy	0	20	60	20						100
La Pocatière	0	20	80							100
REGION 3										
Normandin	20	40	40							80
Kapuskasing	0	25	24	15	35	1				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 splitting |
| 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, 10 and 11 occurred for this species.

Table 2: Breakdown of *Lonicera involucrata* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
51-100	76	10	0	0	0	100	5	0	0	0	100	5	0	0	0	95	5	0	0	0					
101-150	24	28	25	58	42	0	95	100	100	92	0	42	17	25	33	5	5	0	0	0					
151-200	0	62	75	42	58	0	0	0	0	8	0	53	17	58	67	0	90	83	92	92					
201 and +	-	-	-	-	-	-	-	-	-	-	0	0	66	17	0	0	0	17	8	8					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	0	10	0	0	0	85	0	0	0	0	10	0	0	0	0	89	5	0	0	0
51-100	43	0	0	0	0	0	5	8	8	0	15	10	0	0	0	90	23	0	8	33	11	95	17	8	33
101-150	57	19	8	8	92	95	80	84	67	18	0	90	92	0	0	0	67	50	75	50	0	0	83	92	67
151-200	0	81	92	58	8	5	5	8	25	82	0	0	8	100	75	0	10	50	17	17	-	-	-	-	-
201 and +	0	0	0	34	0	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-

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Magnolia kobus DC.

See colour plate

Family	:	Magnoliaceae
English name	:	Northern Japanese magnolia
French name	:	Magnolier
Synonym	:	<i>M. Kobus</i> DC var. <i>Kobus</i> , <i>M. thurberi</i>
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This small tree, with a slender growth habit, could reach a height of 12 m but the individuals at the Montreal Botanical Garden have not exceeded 6 m after 40 years. It is often found growing as a multi-stemmed tree. The crown is conical when young and subsequently becomes rounded.

The branches are coarse and spreading. The bark is smooth, brown and becomes silvery-grey with age.

The conical terminal buds are covered with a single pubescent scale.

The simple, alternate, elliptic or obovate leaves are 8 to 15 cm long and 3 to 11 cm wide and abruptly tapered at the tip. They are glabrous on the upper surface and pubescent underneath, particularly on the veins. The petiole is 10 to 15 mm long. The foliage is dark green during the summer season and the fall colour is dull.

The flower buds form before the end of the growing season for the following year. They are thick and pubescent. The flowers appear before leafing. They are pinkish-white, erect, very fragrant and approximately 8 to 10 cm across. The tree reaches its full flowering potential at around the age of 20 to 30.

The fruits, follicles in cone-like aggregates, bear several very decorative orange seeds.

ORIGIN AND DISTRIBUTION

This Asian species is common on the lower slopes of mountains in Japan and Korea. It was introduced in Europe around 1865.

USE

Ornamental: This small tree is used standing alone or in groups for its very abundant and spectacular spring flowering.

REQUIREMENTS

It is preferable to transplant this species by the root ball method in order to obtain better resumption of growth. It adapts to all soil types, even clay soils or those with traces of limestone. However, it prefers rich, deep, well-drained soils.

Flowering may be reduced depending on the year; the flower buds do not always withstand winter conditions. In addition, the flowers which bloom very early in the spring can be damaged by spring frosts.

PATHOLOGY

This species is sensitive to root rot and this results in withering of the tree.

Frequent frost damage on the leaf buds allows grey mould to develop.

PROPAGATION

Seedlings: The seeds are gathered in the fall, cleaned and generally sown in an outside frame. Germination takes place 12 to 18 months later. When seeding is done in the fall, it is recommended that the seeds be covered in order to avoid possible damage from late frost or spring frost. The young seedlings must be shaded during the first year of growth.

Layering: It is possible to layer magnolias in the spring. It takes two years on average for layers to take root.

Propagation by cuttings: This species propagates easily 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: The seeds were harvested on September 25, 1984 from 20-year-old parent plants. They were kept in the refrigerator at 5°C for the whole winter. They were sown in flats on May 1, 1985. The seedlings were potted on August 15 and placed in a frame. At that time, they were very unequal in size, ranging from 5 to 12 cm. The winter survival rate was 80%. They were shipped in the spring of 1986.

Inclusion in test network: Young seedlings 5 to 12 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Almost all the seedlings died at Normandin and no plants survived at Kapuskasing.

Region 1

At L'Assomption on sand, most of the trees suffered mild frost damage every year. As well, two seedlings died during the first two winters.

At the site on clay, damage was very similar but mortality was somewhat higher; one seedling died the second winter and three others died the fourth.

At Sainte-Clotilde, no damage was observed following the first and last winters. The second winter, all the seedlings suffered frost damage on the stem tips and one seedling died. The following winter, 50% of the trees exhibited frost damage on the stem tips or on the entire previous year's shoot. Slight damage occurred on 67% of the seedlings the fourth winter.

Region 2

At Deschambault, mechanical breakage was observed on 10% to 25% of the seedlings every year. As well, 50% to 80% of the seedlings suffered mild frost damage on the stem tips annually. This was the only site where all the seedlings survived.

At Sainte-Foy, the most common damage was frost damage on the stem tips, on at least 65% of the seedlings every year.

At La Pocatière, 15% to 30% of the seedlings died annually and 25% to 100% of the living seedlings suffered frost damage on the stem tips. More severe damage also occurred on a few plants.

Region 3

At Normandin, 80% of the seedlings died following the first two winters and, at Kapuskasing, none of the plants survived beyond the first winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.16 m R2 = 0.80 m R3 = 0.56 m*

* The average for region 3 represents the Normandin site only.

Categories

The average height of the trees after five years varied from one station to another:

1.26 - 1.50 m: Sainte-Clotilde
 1.01 - 1.25 m: L'Assomption on sand
 0.76 - 1.00 m: Sainte-Foy, Deschambault and L'Assomption on clay
 0.51 - 0.75 m: Normandin
 0.50 m and - : La Pocatière

Effect of pruning

Very severe pruning was carried out at Sainte-Foy following the fourth winter. This pruning was not related to the winter damage suffered by the seedlings.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Magnolia kobus* DC.*Production**

This species clearly grew more quickly in the region south of Montreal. It took two years of growth at Sainte-Clotilde to obtain seedlings 50 cm to 100 cm high and an additional year at L'Assomption on sand to obtain a comparable quantity of seedlings of the same height.

Winter damage was very common with this species. Commercial production of this species in Quebec can be considered only in the warmest region.

Use

This species is very frost-sensitive and its mortality was very high, even total, in zones 4a, 2b and 2a. Flowering, the main ornamental feature of this species, is expressed virtually only in climatic zone 5, as defined by Buckley. However, this species can survive in zone 4b and occasionally flower there if it is well protected against harsh winter conditions.

BIBLIOGRAPHICAL REFERENCES

2, 4, 6, 12, 13, 16, 27, 35, 49, 57

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Table 1: Frequency of winter damage observed on *Magnolia kobus* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	4	6	7	8	5 and 9	10	11	14		
REGION 1												
L'Assomption-clay	30	67				3					70	
L'Assomption-sand	41	50				6			3		59	
Sainte-Clotilde	57	34	8			1					43	
REGION 2												
Deschambault	20	65						15			80	
Sainte-Foy	34	63				2	1				66	
La Pocatière	29	46	2	8	1	14					71	
REGION 3												
Normandin ^b	35	20	25			20					65	
Kapuskasing	0					100					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 splitting |
| 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 types 3 and 14 occurred for this species.

^b This average is not very representative since only four seedlings out of 21 survived more than three years.

Table 2: Breakdown of *Magnolia kobus* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																									
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde															
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90											
0-50	100	75	25	0	0	100	95	91	45	0	100	30	0	0	0											
51-100	0	25	75	100	17	0	5	9	55	75	0	70	100	50	0											
101-150	0	0	0	0	67	0	0	0	0	25	0	0	0	50	83											
151-200	0	0	0	0	16	-	-	-	-	-	0	0	0	0	17											
Height (cm)	REGION 2										REGION 3															
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing					
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	
0-50	100	100	8	0	9	100	95	58	8	0	100	100	100	100	89	100	100	100	25	25	100	0	0	0	0	0
51-100	0	0	92	83	36	0	5	42	84	75	0	0	0	0	11	0	0	0	75	75	-	-	-	-	-	
101-150	0	0	0	17	55	0	0	0	8	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Malus baccata (L.) Borkh. (C)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the first series of descriptive reports (publication 02-9227).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Arboretum of the Montreal Botanical Garden

Propagation site: Montreal Botanical Garden

Propagation technique: The seeds were harvested in October 1982 from 40-year-old parent plants. They were sown in early November in a frame, after first being cleaned of their fleshy pericarp. They germinated in May 1983 and the seedlings, dug up in the fall of 1984, were heeled in until they were shipped in May 1985.

RESULTS (1985-1990)

Winter damage

More than 75% of the seedlings did not suffer any damage, with the exception of those at Sainte-Anne-de-Bellevue; the damage was mainly frost damage to the tip of the previous year's shoot.

The majority of the damage occurred the first two winters. At most of the sites, mortality occurred on seedlings that had not grown during the first year.

Region 1

Mortality was occasional at all the sites, except at L'Assomption on clay where it increased the first three winters, killing six seedlings. However, no growth had been noted during the first two years for all the plants which died.

With the exception of a few isolated cases of mortality, no damage was observed at the Sainte-Clotilde site and at the two L'Assomption sites. At Sainte-Anne-de-Bellevue, frost damage on the tips of the branches annually affected between 10% and 90% of the seedlings.

Region 2

No damage was noted at Deschambault during the five years of testing.

At Sainte-Foy, between 50% and 75% of the seedlings suffered frost damage on the tip of the branches, following the first two winters only. Mortality occurred in 1986 and 1987; the two seedlings that died had exhibited no growth since planting.

Between 20% and 34% of the seedlings at La Pocatière suffered slight damage on the stem tips following the second and fifth winters.

Region 3

Normandin and Kapuskasing were the only sites where mechanical breakage related to weather conditions affected some of the seedlings, the first winter at Normandin and the last two winters at Kapuskasing.

There was generally less winter damage at Kapuskasing, since aside from the three seedlings that died the first winter, all the seedlings were undamaged.

At Normandin, 40% of the seedlings suffered slight frost damage the second winter and 8% of the seedlings suffered frost damage on the previous year's shoot during the third winter.

Growth in height

After five years, the average height of the seedlings for each region was:

R1 = 3.40 m R2 = 3.28 m R3 = 2.82 m

At the Kapuskasing site, growth was less vigorous than elsewhere, although it was very regular the last four years. For the other sites, growth in height was not statistically different, although it was greater at Sainte-Anne-de-Bellevue and at Sainte-Clotilde.

Categories

The average height of the trees after five years varied from one site to another:

- 3.51 - 4.00 m: Sainte-Anne-de-Bellevue and Sainte-Clotilde
- 3.26 - 3.50 m: L'Assomption on sand, Sainte-Foy and La Pocatière
- 3.01 - 3.25 m: Normandin
- 2.76 - 3.00 m: Deschambault and L'Assomption on clay
- 2.51 - 2.75 m: Kapuskasing

Effect of pruning

At all the sites, very little pruning was done on the principal axis of the trees, but selection and training of the frame required extensive pruning.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 52.6 mm R2 = 47.6 mm R3 = 38.8 mm

Contrary to the results obtained with the *Malus baccata* seedlings established in 1984, a growth gradient was noted between the regions, with the trees in region 3 having a smaller diameter for each of the five years of observation. This is explained by the fact that the growth of the trees established at Normandin in 1985 was poorer than that of the trees established in 1984.

At Kapuskasing, the trunk diameter began to increase during the third year, while at the other sites, significant growth was noted during the second year.

Categories

The average diameter of the trees after five years varied from one site to another:

- 51 - 55 mm: L'Assomption on sand and on clay, La Pocatière and Sainte-Anne-de-Bellevue
- 46 - 50 mm: Sainte-Clotilde and Sainte-Foy
- 41 - 45 mm: Deschambault
- 36 - 40 mm: Normandin and Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the potential annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

At all the test sites, except Normandin and Kapuskasing, more than 80% of the trees had attained a trunk diameter of between 21 and 30 mm after the third year of production. At these two sites, an additional year was required to obtain the same percentage of trees of this diameter.

At Sainte-Clotilde, Sainte-Anne-de-Bellevue, Sainte-Foy and L'Assomption on sand, 80% of the trees had attained a height of between 2 and 3 m by the end of the third year. To obtain a height of 2 m or more for 90% of the plants, it took five years at Kapuskasing and four years at all the other sites.

At the end of the testing period, the trees at the Normandin and Kapuskasing sites had a smaller diameter than that observed at the other sites, and the height of the trees at Kapuskasing was also lower.

Use

Malus baccata is a very hardy species. The results obtained demonstrate that the zone rating of 2b, established by Sherk and Buckley, is slightly underestimated and that this plant tolerates equally well the climatic conditions associated with regions zoned 2a. This species can be used without risk of serious damage anywhere in Quebec and northeastern Ontario, even in zone 1b.

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Table 1: Frequency of winter damage observed on *Malus baccata* from 1985 to 1990

Test sites	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	93					7				7	
L'Assomption-sand	99					1				1	
Ste-Anne-de-Bellevue	51	44	2			1			2	49	
Sainte-Clotilde	98					2				2	
REGION 2											
Deschambault	100									0	
Sainte-Foy	75	24				1				25	
La Pocatière	88	11				1				12	
REGION 3											
Normandin	75	9	2					14		25	
Kapuskasing	92					3		5		8	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

Damage of types 3, 5, 6, 7 and 9 was not observed for this species.

Table 2: Breakdown of *Malus baccata* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-15	100	45	0	0	0	100	35	0	0	0	100	0	0	0	0	100	35	0	0	0					
16-20	0	45	17	0	0	0	22	10	0	0	0	72	0	0	0	0	15	17	0	0					
21-25	0	10	8	0	0	0	43	0	10	0	0	28	8	9	0	0	45	0	0	0					
26-30	0	0	58	17	0	0	0	20	0	0	0	0	58	9	9	0	5	17	8	0					
31-40	0	0	17	42	0	0	0	60	20	20	0	0	34	27	0	0	0	33	17	9					
41-50	0	0	0	33	50	0	0	10	70	20	0	0	0	55	55	0	0	33	33	25					
51-60	0	0	0	8	25	0	0	0	0	30	0	0	0	0	27	0	0	0	42	33					
61 and +	0	0	0	0	25	0	0	0	0	30	0	0	0	0	9	0	0	0	0	33					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-15	100	35	0	0	0	100	19	17	0	0	100	45	0	0	0	100	66	17	0	0	100	100	17	0	0
16-20	0	45	9	0	0	0	62	0	0	0	0	55	8	0	0	0	34	25	25	0	0	0	42	0	0
21-25	0	15	9	9	0	0	19	33	8	0	0	0	17	0	0	0	0	33	13	8	0	0	41	0	0
26-30	0	5	18	9	9	0	0	42	8	0	0	0	33	0	0	0	0	17	13	8	0	0	0	17	0
31-40	0	0	55	46	9	0	0	8	25	17	0	0	42	50	9	0	0	8	37	50	0	0	0	66	75
41-50	0	0	9	27	46	0	0	0	50	17	0	0	0	33	33	0	0	0	12	25	0	0	0	17	25
51-60	0	0	0	9	18	0	0	0	9	58	0	0	0	17	33	0	0	0	0	9	-	-	-	-	-
61 and +	0	0	0	0	18	0	0	0	0	8	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Malus baccata* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	95	10	0	0	0	70	14	0	0	0	57	0	0	0	0	67	20	0	0	0
101-150	5	50	0	0	0	30	43	10	10	0	43	29	0	0	0	33	40	8	0	0
151-200	0	40	83	0	0	0	36	10	0	10	0	52	0	0	0	0	40	9	0	0
201-300	0	0	17	92	17	0	7	80	90	50	0	19	100	82	18	0	0	83	58	0
301-350	0	0	0	0	33	0	0	0	0	30	0	0	0	18	27	0	0	0	25	33
351-400	0	0	0	8	42	0	0	0	0	10	0	0	0	0	46	0	0	0	17	42
401-450	0	0	0	0	8	-	-	-	-	-	0	0	0	0	9	0	0	0	0	25

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	24	0	0	0	0	95	10	0	0	0	95	10	0	0	0	100	14	0	0	0	100	56	0	0	0
101-150	76	15	0	0	0	5	71	9	0	0	5	70	8	0	0	0	62	0	0	0	0	44	58	0	0
151-200	0	65	10	0	0	0	19	58	25	0	0	20	25	8	0	0	24	58	8	8	0	0	42	50	0
201-300	0	20	81	54	18	0	0	33	58	75	0	0	67	67	17	0	0	42	75	17	0	0	0	50	100
301-350	0	0	9	36	36	0	0	0	17	0	0	0	0	25	42	0	0	0	17	50	-	-	-	-	-
351-400	0	0	0	10	36	0	0	0	0	25	0	0	0	0	33	0	0	0	0	25	-	-	-	-	-
401-450	0	0	0	0	10	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-

Malus baccata (L.) Borkh. (C)

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the first series of descriptive reports (publication 02-9227).

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 1990 from 40-year-old parent plants in very good condition. The seeds were cleaned of their fleshy pericarp and sown in early November in an outside frame. They germinated in May 1991. The seedlings were dug up in the fall and heeled in; 200 seedlings were transplanted to the nursery in May 1992. In the spring of 1993, they were dug up and wrapped, then shipped in May.

Inclusion in test network: Young seedlings 35 to 40 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Mortality occurred on planting at two sites, particularly at Deschambault where 38% of the seedlings did not take. Five of the eight sites suffered losses during the testing period.

Region 1

No damage occurred at the L'Assomption site on sand.

At the L'Assomption site on clay, 67% of the seedlings were damaged by rodents during the second winter and 17% the fourth winter, causing the death of one plant the last year.

At Sainte-Clotilde, 28% of the seedlings suffered frost damage on the stem tips and one plant died during the second winter. The following winter, 17% of the seedlings suffered frost damage on the previous year's shoot. A second plant died the fourth winter.

Region 2

At Sainte-Foy, more than 90% of the seedlings did not suffer any damage the last four winters. One seedling died during the fourth winter and 28% of the seedlings suffered frost damage on the stem tips the first winter.

At Deschambault, little winter damage was observed on the seedlings that had taken well following establishment.

At La Pocatière, 20% of the seedlings exhibited frost damage on the stem tips following the first winter and no other damage was observed.

Region 3

At Normandin, 80% or more of the seedlings did not suffer any damage the last three years. The first winter, 81% of the seedlings exhibited frost damage on the stem tips. The following winter, 24% of the seedlings suffered this type of damage and 15% suffered frost damage on the previous year's shoot. The last two winters, three seedlings died; all were in the same replication.

At Kapuskasing, damage was observed mainly during the first winter: 95% of the seedlings exhibited frost damage on the stem tips and one plant died. The third winter, 15% of the seedlings suffered frost damage on the previous year's shoot.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.45 m R2 = 3.38 m R3 = 2.88 m

The seedlings at the L'Assomption on clay and La Pocatière sites brought down their respective regional averages.

Categories

The average height of the trees after five years varied from one station to another:

- 3.51 - 4.00 m: L'Assomption on sand, Sainte-Foy, Sainte-Clotilde and Deschambault
- 3.01 - 3.50 m: Normandin (heavy soils)
- 2.51 - 3.00 m: L'Assomption on clay, La Pocatière and Kapuskasing (heavy soils)

Effect of pruning

No pruning was necessary other than pruning for shaping.

Growth of trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 53 mm R2 = 56 mm R3 = 45 mm

There was significant variation between the sites in the same region.

Categories

The average diameter of the trees after five years varied from one station to another:

- 61 mm and + : L'Assomption on sand and Sainte-Foy
- 56 - 60 mm : Deschambault
- 51 - 55 mm : L'Assomption on clay
- 46 - 50 mm : La Pocatière, Sainte-Clotilde and Normandin
- 45 mm and - : Kapuskasing

No growth was observed at Sainte-Clotilde the last year.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined trunk diameter or height.

Production

After two years of production, 90% of the trees at L'Assomption on sand and Sainte-Foy had attained a trunk diameter of between 21 and 40 mm; similarly 67% and 70% of the trees at L'Assomption on clay and Sainte-Clotilde had attained this size.

A third year of production was necessary at the other sites, with the exception of Kapuskasing, where a fourth year was required to obtain trees of similar diameter.

After two years, all the trees in the test were 1 m high or higher.

Use

Malus baccata is a very hardy species. The results obtained demonstrate that the zone rating of 2b, established by Sherk and Buckley, is slightly underestimated and that this plant tolerates equally well the climatic conditions associated with regions zoned 2a. This species can be used without risk of serious damage anywhere in Quebec and northeastern Ontario, even in zone 1b.

WRITTEN BY

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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Malus baccata* from 1986 to 1991

Test sites	No damage 1	Percentage breakdown of damage								Cumulative damage	
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	78					2		3	17		22
L'Assomption-sand	100										0
Sainte-Clotilde	88	6	3			3					12
REGION 2											
Deschambault	98							2			2
Sainte-Foy	92	6				2					8
La Pocatière	96	4									4
REGION 3											
Normandin	71	21	3			5					29
Kapuskasing	75	19	3			1		2			25

- ^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 splitting |
| 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 types 3, 5, 6, 7, 9 and 14 occurred for this species.

Table 2: Breakdown of *Malus baccata* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0										
51-100	90	0	0	0	0	95	0	0	0	0	48	0	0	0	0										
101-150	5	20	8	0	0	0	57	67	8	0	52	10	0	0	0										
151-200	0	75	9	0	0	0	43	0	42	0	0	10	0	0	0										
201-250	0	5	50	0	0	0	0	33	17	18	0	70	33	8	0										
251 and +	0	0	33	100	100	0	0	0	33	82	0	10	67	92	100										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	21	0	0	0	0	43	0	0	0	0	0	0	0	0	0	5	0	0	0	0
51-100	38	0	0	0	0	71	0	0	0	0	57	48	0	0	0	57	10	0	0	0	85	0	0	0	0
101-150	62	9	0	0	0	8	54	0	0	0	0	52	25	0	0	43	24	8	0	0	10	74	0	0	0
151-200	0	29	0	0	0	0	46	40	0	0	0	0	75	8	0	0	66	17	8	0	0	26	58	9	17
201-250	0	62	50	8	0	0	0	30	10	0	0	0	0	67	17	0	0	67	33	0	0	0	42	66	17
251 and +	0	0	50	92	100	0	0	30	90	100	0	0	0	25	83	0	0	8	59	100	0	0	0	25	66

Table 3: Breakdown of *Malus baccata* plants by marketable trunk diameter category from 1986 to 1990

Trunk diameter (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	10	0	0	0	100	33	33	8	0	100	30	8	0	0
21-40	0	90	42	0	0	0	67	67	42	9	0	70	83	33	18
41-60	0	0	58	83	17	0	0	0	50	45	0	0	9	67	72
61-80	0	0	0	17	83	0	0	0	0	46	0	0	0	0	10

Trunk diameter (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	10	0	0	0	100	54	0	0	0	100	100	8	8	0	100	67	8	0	0	100	95	0	0	0
21-40	0	90	58	0	0	0	46	100	20	0	0	0	92	92	8	0	33	92	75	22	0	5	0	31	42
41-60	0	0	42	100	45	0	0	0	80	60	0	0	0	0	92	0	0	0	25	78	0	0	0	69	58
61-80	0	0	0	0	55	0	0	0	0	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Myrica Gale L.

See colour plate

Family	:	Myricaceae
English name	:	Sweet gale
French name	:	Myrique baumier (bois sent-bon)
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This bushy shrub with a semi-globular growth habit can reach a height of 1 m. The small branches are gland-dotted, glabrous and brownish. The buds are oval and greenish.

The foliage is dull green. The leaves are alternate, oblong, lanceolate and dentate at the apex and are 3 to 5 cm long and 2 cm wide. They are dark green, glabrous above and generally pubescent beneath. The petiole is 1 to 3 mm long.

The wood and the leaves give off a pleasant aroma when crushed.

Flowering takes place in the spring. The flowers are dioecious and are 1.5 cm long. The staminate catkins appear before or with the leaves. They are brown and triangular, with small scales which open to disperse the pollen. The female flowers, clustered in spikes, are ovoid and globular.

The fruits, drupes, are waxy, winged, golden and gland-dotted. The ovary is smooth and flanked by two bractlets which develop into spongy floaters to assist dispersal.

The roots have bacteroid nodules similar to those on leguminous plants.

ORIGIN AND DISTRIBUTION

The name of this species comes from a Greek work which means "perfume". This species has a very wide geographical distribution (northern Eurasia, North America). It is one of the most widespread shrubs along the shores of lakes in the Laurentian region and along riverbanks. It is frequently found in Ontario and even north of Hudson's Bay.

USE

Ornamental: This species can be used standing alone, in clumps or for naturalization purposes along the shores of lakes.

Insect repellent: The crushed leaves are placed in a cloth and the odour released repels insects.

Food uses: The leaves can be used as a condiment. The young branches are browsed by deer.

REQUIREMENTS

This species is suited to moist, sandy areas.

PATHOLOGY

To our knowledge, no serious disease affects this species.

PROPAGATION

Seedlings: Natural propagation is by seeds.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Seeds from James Bay, Quebec

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

Propagation technique: The seeds were sown on June 1, 1983 in a greenhouse, after being soaked in water for two weeks. The seedlings were potted in individual cells in August and placed outside until the fall of 1983. On June 6, 1984, the seedlings were transplanted to the nursery. In early May 1985, they were dug up, wrapped and placed in a cold store until they were shipped a few days later.

Inclusion in test network: Young seedlings 15 cm high and wide were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Only one seedling died the last winter at Sainte-Anne-de-Bellevue. This species is very little affected by winter frost damage.

Region 1

No frost damage affected the seedlings during the five years, with the exception of the Sainte-Anne-de-Bellevue site, where frost damage on the stem tips occurred on all the seedlings the last winter. In addition, one shrub died during this same winter.

Region 2

Only one seedling suffered frost damage on the stem tips at Sainte-Foy and at La Pocatière.

Region 3

All of the seedlings at Normandin and more than 80% of the seedlings at Kapuskasing suffered no frost damage during the testing period: 15% of the seedlings at Kapuskasing suffered frost damage on the stem tips following the winter of 1986-1987 and two shrubs were affected on the trunk and by the snow the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.52 m R2 = 0.70 m R3 = 0.2 m

The highest seedlings were those in region 2.

Categories

The average height of the shrubs after five years varied from one site to another:

71 - 80 cm:	Sainte-Foy and Deschambault
61 - 70 cm:	L'Assomption on sand and Normandin
51 - 60 cm:	La Pocatière
41 - 50 cm:	Sainte-Anne-de-Bellevue, Sainte-Clotilde, L'Assomption on clay and Kapuskasing

Effect of pruning

This species required no pruning.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.81 m	R2 = 1.01 m
R3 = Normandin: 1.08 m*	
Kapuskasing: 0.55 m	

* The regional average of the width of the seedlings cannot be calculated because of the significant difference between the two sites.

Categories

The average width of the shrubs after five years varied from one site to another:

1.00 and + :	Sainte-Foy and Normandin
91 - 1.00 cm:	Deschambault, Sainte-Clotilde and La Pocatière
81 - 90 cm :	Sainte-Anne-de-Bellevue and L'Assomption on sand
71 - 80 cm :	-
61 - 70 cm :	-
51 - 60 cm :	L'Assomption on clay and Kapuskasing

Flowering

Depending on the year, the beginning of the flowering period varied from April 9 to May 1 for the sites in region 1, from May 1 to May 4 for the sites in region 2 and from May 1 to May 13 for the sites in region 3. The flowers appeared much earlier at the sites located in climatic zone 5.

The flowering period lasted on average 15 to 20 days at all the sites. Flowering was inconspicuous and occurred before or at the same time as leafing.

The seedlings with female flowers produced abundant amounts of fruit.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The production of this species was significantly faster at certain sites in region 2; 85% of the seedlings at Deschambault and all of those at Sainte-Foy had attained a height of 40 cm or more after two years. A third year was necessary at L'Assomption on sand, Sainte-Clotilde and Normandin to obtain plants of the same height.

Clay soils seem to be a limiting factor for the growth of this species.

Use

This species is quite hardy throughout Quebec and can be recommended as far north as zone 1b, without serious risk of winter damage.

Myrica Gale L.

However, the origin of the seeds significantly influences the rate of growth and development. The clone tested came from James Bay and seemed to do better at the sites in the Quebec City region than at those in the Montreal region.

It would be interesting to repeat the test with seeds of different origin.

BIBLIOGRAPHICAL REFERENCES

3, 57, 60, 65, 71, 86, 95

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Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Myrica Gale* from 1985 to 1990

Test sites	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	100									0
L'Assomption-sand	100									0
Ste-Anne-de-Bellevue	79	19				2				21
Sainte-Clotilde	100									0
REGION 2										
Deschambault	100									0
Sainte-Foy	99	1								1
La Pocatière	98	2								2
REGION 3										
Normandin	100									0
Kapuskasing	93	3					2	2		7

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 4, 6, 7 and 11 occurred for this species.

Table 2: Breakdown of *Myrica Gale* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	29	10	0	0	0	48	19	0	0	0	62	10	0	0	0	85	14	0	0	0
21-40	71	52	25	17	0	52	81	92	50	42	38	81	25	8	25	15	81	58	58	17
41-60	0	38	50	58	17	0	0	8	50	58	0	9	75	67	67	0	5	42	17	75
61-80	0	0	25	25	83	-	-	-	-	-	0	0	0	25	8	0	0	0	25	8
81-100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	9	0	0	0	0	20	0	0	0	0	95	14	8	0	0	10	0	0	0	0	57	24	8	0	0
21-40	81	0	0	0	0	80	15	17	0	0	5	86	75	50	0	76	86	8	0	0	43	76	83	83	42
41-60	10	76	67	42	0	0	85	33	17	17	0	0	17	50	67	14	14	84	67	58	0	0	9	17	50
61-80	0	24	33	58	67	0	0	42	75	66	0	0	0	0	33	0	0	8	25	33	0	0	0	0	8
81-100	0	0	0	0	33	0	0	8	8	17	-	-	-	-	-	0	0	0	8	9	-	-	-	-	-

Table 3: Breakdown of *Myrica Gale* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	21	0	0	0	0	28	28	9	0	9	33	0	0	0	0	81	0	0	0	0
26-50	64	24	8	8	8	57	72	58	25	33	67	19	0	0	0	19	62	17	17	0
51-75	15	48	42	50	17	15	0	25	75	50	0	76	58	17	8	0	38	58	42	25
76-100	0	28	50	42	67	0	0	8	0	8	0	5	33	33	58	0	0	25	41	67
101-125	0	0	0	0	8	-	-	-	-	-	0	0	9	50	34	0	0	0	0	8
126-150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	5	0	0	0	0	55	5	0	0	0	95	5	0	0	0	43	0	0	0	0	71	33	25	8	0
26-50	71	5	0	0	0	40	25	8	0	0	5	71	58	0	0	52	57	0	0	0	29	67	75	67	25
51-75	24	43	0	0	0	5	65	75	17	17	0	24	42	58	8	5	38	8	17	0	0	0	0	25	68
76-100	0	48	33	92	17	0	5	17	42	42	0	0	0	42	67	0	5	75	67	50	0	0	0	0	7
101-125	0	4	59	8	75	0	0	0	41	33	0	0	0	0	25	0	0	17	8	42	-	-	-	-	-
126-150	0	0	8	0	8	0	0	0	0	8	-	-	-	-	-	0	0	0	8	8	-	-	-	-	-

Acer ginnala



Jacques Allard

Acer negundo



Raynald Drapeau

Acer rubrum



Jacques Allard

Acer rubrum



Michel Auger

Acer tataricum



Claude Richer Leclerc

Aesculus hippocastanum



Jacques Côté

Actinidia Kolomikta



Jacques Côté

Actinidia Kolomikta



Jacques Allard

Alnus crispa



Mike Blého

Alnus crispa



Mike Blého

Alnus glutinosa



Jacques-André Rioux

Alnus glutinosa



Claude Richer Leclerc

Betula alleghaniensis



Jacques Côté

Betula alleghaniensis



Jacques Côté

Betula nigra



Jacques Côté

Betula nigra



Claude Richer Leclerc

Betula pendula



Jacques Allard

Calluna vulgaris 'Alportii'



Jacques Allard

Caragana arborescens



Jacques-André Rioux

Caragana



Mike Blého

Caragana spinosa



Jacques Côté

Celtis occidentalis



Claude Richer Leclerc

Clematis virginiana



Mike Blého

Clematis virginiana



Jacques Côté

Cornus alba 'Spaethii'



Jacques-André Rioux

Cornus alternifolia



Jacques Côté

Cornus sanguinea



Jacques Côté

Cornus sanguinea



Jacques Côté

Cornus sericea 'Flaviramea'



Jacques Côté

Cornus sericea 'Flaviramea'



Jacques Côté

Corylus avellana x cornuta



Raynald Drapeau

Cotoneaster apiculatus



Jacques Côté

Cotoneaster apiculatus



Jacques Allard

Cotoneaster dammeri 'Skogholm'



Jacques-André Rioux

Cotoneaster dammeri 'Skogholm'

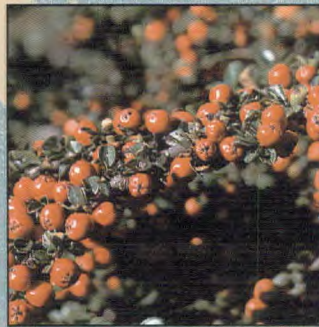


Jacques Allard

Cotoneaster horizontalis var. *perpusillus*



Jacques Côté



Jacques Allard

Elaeagnus angustifolia



Jacques Allard

Elaeagnus angustifolia



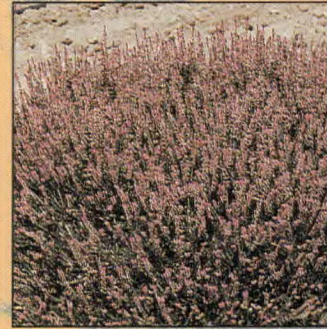
Jacques Allard

Elaeagnus commutata



Mike Bleho

Erica carnea 'Praecox'



Charles Péron

Euonymus alatus 'Compactus'



Jacques Côté

Euonymus alatus 'Compactus'



Jacques Côté

Euonymus europaeus



Jacques Côté

Euonymus europaeus



Jacques Côté

Forsythia ovata 'Northern Gold'



Jacques Côté

Forsythia ovata 'Northern Gold'



Jacques Côté

Hippophae rhamnoides



Jacques-André Rioux

Hippophae rhamnoides



Claude Richer Leclerc

Hydrangea arborescens 'Annabelle'



Jacques Côté

Hydrangea arborescens 'Annabelle'



Jacques Côté

Juniperus chinensis 'Hetzii'



Jacques Côté

Juniperus conferta



Claude Richer Leclerc

Juniperus sabina



Raynald Drapeau

Juniperus virginiana



Mike Blého

Larix decidua



Jacques-André Rioux

Larix decidua



Jacques Allard

Larix laricina



Jacques Allard

Lonicera involucrata



Jacques-André Rioux

Lonicera involucrata



Raynald Drapeau

Magnolia kobus



Jacques Côté

Magnolia kobus



Jacques Allard

Myrica Gale



Jacques-André Rioux

Philadelphus x virginalis 'Minnesota Snowflake'



Jacques Côté

Philadelphus x virginalis 'Virginal'



Jacques Côté

Picea pungens



Jacques Côté

Picea pungens 'Glauca'



Jacques Allard

Pinus nigra 'Austriaca'



Claude Ficher Ledlerc

Pinus sylvestris



Raynald Drapsau

Potentilla fruticosa 'Abbotswood'



Jacques Côté

Potentilla fruticosa 'Abbotswood'



Jacques Côté

Potentilla fruticosa 'Daydawn'



Raynald Drapeau

Potentilla fruticosa 'Snowflake'



Mike Bleho

Prunus padus



Raynald Drapeau

Prunus padus



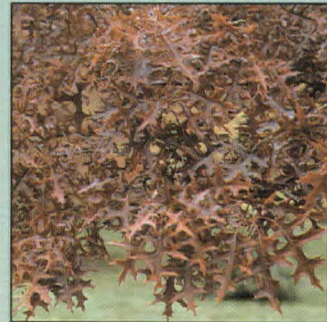
Raynald Drapeau

Quercus palustris



Jacques-André Rioux

Quercus palustris



Jacques Allard

Quercus robur 'Fastigiata'



Jacques Côté

Quercus rubra



Jacques Allard

Rhododendron carolinianum var. *album*



Jacques Allard

Rhododendron carolinianum



Claude Richer Leclerc

Rhododendron carolinianum var. *roseum*



Jacques Allard

Rhododendron mucronulatum



Jacques Côté

Ribes aureum



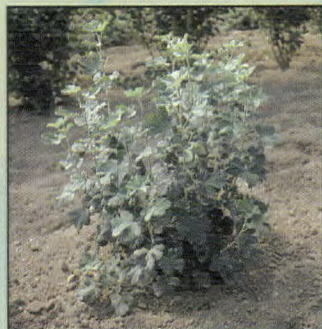
Jacques Côté

Ribes aureum



Jacques Côté

Ribes sanguineum



Jacques-André Floux

Ribes sanguineum



Jacques Allard

Rosa 'Martin Frobisher'



Raynald Drapeau

Rosa x Metis



Jacques Allard

Rosa x Metis



Jacques Allard

Rosa multiflora



Jacques Côté

Rosa rugosa var. *typica*



Jacques Côté

Shepherdia argentea



Charles Péron

Shepherdia argentea



Charles Péron

Spiraea japonica 'Goldmound'



Jacques Côté

Spiraea japonica 'Goldmound'



Jacques-André Rioux

Spiraea nipponica 'Snowmound'



Jacques Côté

Spiraea nipponica 'Snowmound'



Jacques-André Rioux

Syringa reticulata



Jacques Côté

Tamarix ramosissima



Jacques Côté

Tamarix ramosissima



Jacques Côté

Thuja occidentalis



Claude Richer Leclerc

Thuja occidentalis 'Fastigiata'



Mike Blého

Thuja occidentalis 'Little Champion'



Michel Auger

Thuja occidentalis 'Lutea'



Michel Auger

Thuja occidentalis 'Pulcherrima'



Jacques Côté

Thuja occidentalis 'Reidii'



Mike Blého

Thuja occidentalis 'Smaragd'



Jacques Côté

Thuja occidentalis 'Wareana'



Claude Richer Leclerc

Thuja occidentalis 'Woodwardii'



Mike Blého

Ulmus pumila



Jacques-André Floux

Ulmus pumila



Jacques-André Floux

Viburnum carlesii



Jacques Allard

Viburnum carlesii



Jacques Allard

Viburnum lantana



Roméo Meloche

Viburnum lantana



Mike Blého

Viburnum lentago



Claude Richer Lelièvre

Viburnum lentago



Roméo Meloche

Viburnum opulus 'Nanum'



Claude Richer Leclerc

Viburnum opulus 'Roseum'



Jacques Côté

Viburnum trilobum



Jacques Côté

Viburnum trilobum



Jacques Allard

Weigela florida 'Variegata'



Jacques Côté

Weigela florida 'Variegata'



Jacques Côté

Parthenocissus quinquefolia (L.) Planch (C)

The sections Botanical Description, Origin and Distribution, Requirements, Pathology, Propagation and Bibliographical References were published previously in the second series of descriptive reports (publication 02-9309).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: Cuttings of 20 cm were taken on July 6, 1984 and treated with a solution of 4,000 ppm IBA. They were placed in a mist propagator in a substrate composed of peat and perlite (2:3). The rooting rate was 100% after three weeks. Potting was carried out on July 30 and August 14. The cuttings were placed outside. Significant growth was noted during September and October. The plants overwintered in an open frame under a thick cover of snow. All the plants suffered frost damage on the stem tips. They were dug up and wrapped on May 7, 1985 for shipment.

Inclusion in test network: Young plants 7 to 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality was very high at the Normandin and Kapuskasing sites, but no plants died at the sites in regions 1 and 2.

Region 1

Frost damage on the stem tips was the only type of damage observed. It occurred during the first winter at L'Assomption on sand and during the fourth winter at

Sainte-Clotilde. At the L'Assomption site on clay, the plants were affected the first and last winters.

At Sainte-Anne-de-Bellevue, the plants were affected the last four winters.

Region 2

Frost damage on the stem tips affected all the plants at Sainte-Foy as well as all the plants at Deschambault three years out of five.

At La Pocatière, 45% of the plants suffered this type of damage the first winter, 60% the second and 100% the last three winters. In addition, 40% of the plants were affected on the previous year's shoot the second winter.

Region 3

At Normandin, 43% of the plants died the second winter and 10% the following winter. In addition, the living plants were affected by frost damage on the stem tips or on the previous year's shoot.

At Kapuskasing, plant mortality increased the first three years, reaching 75%: only three plants survived the testing period. All the types of damage caused by frost occurred at various times.

Growth in height

After five years, the average height of the plants for each region was:

R1 = 2.34 m R2 = 1.53 m R3 = 1.05 m

Categories

The average height of the plants after five years varied from one site to another:

3.51 m and + : Sainte-Anne-de-Bellevue
2.51 - 3.00 m: -
1.51 - 2.50 m: Sainte-Foy, L'Assomption on sand and on clay, Sainte-Clotilde, La Pocatière and Normandin
1.50 m and - : Deschambault and Kapuskasing

The best growth was observed every year at Sainte-Anne-de-Bellevue. There was almost no growth during the entire testing period at Kapuskasing.

In general, once the plants were established, annual growth was greater than 1 m. At Deschambault, growth was poor the first and last years and particularly significant the third.

Effect of pruning

The plants were cut back every spring to between 15 and 30 cm from the ground.

RECOMMENDATIONS

Production

The height and width of the plants are not marketing criteria for this species. Production of an ivy is a particular feature since the plant is sold based on its age. After the first year, almost all the plants, with the exception of those at Kapuskasing, had attained a height of more than 1 m.

Use

The test results demonstrated that the zoning established by Sherk and Buckley (zone 2b) was overestimated, since the plants suffered serious frost damage at the sites in region 3 as well as high mortality at Kapuskasing. Since there was no test site in zone 3, we were unable to determine the zone rating limit of the species. However, in zone 4, no mortality occurred and growth was excellent.

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Laurier Guillemette, Agr.

Table 1: Frequency of winter damage observed on *Parthenocissus quinquefolia* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	67	33								33
L'Assomption-sand	80	20								20
Ste-Anne-de-Bellevue	20	80								80
Sainte-Clotilde	80	20								20
REGION 2										
Deschambault	41	59								59
Sainte-Foy	0	100								100
La Pocatière	11	81	8							89
REGION 3										
Normandin	0	38	52			10				100
Kapuskasing	24	2	30	6	11	27				76

- ^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 splitting |
| 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 5, 9, 10 and 11 occurred for this species.

Philadelphus X virginalis 'Minnesota Snowflake'

See colour plate

Family	:	Saxifragaceae
English name	:	Minnesota Snowflake mock orange
French name	:	Séringat 'Minnesota Snowflake'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub can attain a height of 1.8 to 2.0 m and a width of more than 1.0 m. Its branches are arched and form regularly from the ground level.

The leaves are very large, dark green and oval. They are abruptly tapered and the base is rounded.

The double flowers are 4 to 5 cm in diameter and occur in racemes of eight to ten very fragrant flowers. There are five petals and approximately 25 modified stamens.

ORIGIN AND DISTRIBUTION

The species is the result of a crossing between *P. X lemoinei* and *P. nivalis* 'Plena'.

This American cultivar was developed around 1935 by Guy D. Bush in Minnesota.

USE

Ornamental: All the *Philadelphus* are recommended for the beauty and abundance of their flowering. This specimen can be used as a background plant in clumps or borders since it is relatively large. However, its growth habit is very regular. New, more compact cultivars are now available on the market.

REQUIREMENTS

In general, the *Philadelphus* adapt to all soil types, including limestone soils and mixed fill. However, they prefer moist, well-drained soils rich in organic matter.

They must be planted in sunny locations. However, large species or cultivars flower well in clumps, provided the branch structure of the trees is not too dense.

The flower buds are formed by the fall and the plants must not be pruned before flowering. The plants can be cut back quite severely after flowering. The growth of this plant is rapid and vigorous.

PATHOLOGY

Aphids often attack this cultivar.

PROPAGATION

Propagation by cuttings: Softwood or semi-hard cuttings are generally used to propagate this cultivar.

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 were taken on June 6, 1984 and soaked in a solution of 4,000 ppm IBA and 50% ethanol. They were placed under mist for an average duration of 30 seconds every seven minutes, in a substrate of perlite (100%). They were potted on July 7 in Fertil Pots[®] in a substrate composed of Pro-Mix[®] (50%), compost (25%) and sand (25%). They were placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young plants 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

At certain sites, more damage was observed during the first few winters, with decreasing severity of damage thereafter.

Region 1

At the L'Assomption site on sand, 26% of the plants died during the second winter and 10% during the fourth. Frost damage on the stem tips occurred on 100%, 36% and 20% of the plants during the first, fourth and last winters.

At the L'Assomption site on clay, the winter response was similar, with slightly more plants affected by frost damage on the stem tips. In addition, the second winter, 17% of the plants suffered frost damage on the previous year's shoot and 17% died. Every year, the plants at Sainte-Clotilde suffered frost damage on the stem tips and even on the previous year's shoot. One plant died during the first winter.

Region 2

At Sainte-Foy, one plant died every year during the first, third and fourth winters. As well, frost damage on the stem tips affected 55% to 100% of the plants the last two winters, while 36% and 10% of the plants suffered frost damage on the previous year's shoot the last two winters.

At Deschambault, 25% of the plants died during the first winter and frost damage occurred on 78% of the plants the following winter, affecting the entire shoot above the level of snow cover. The third winter, damage was limited to the previous year's shoot. Frost damage on the stem tips was observed following the last two winters.

At La Pocatière, 67% of the plants died during the first winter and 23% the two following winters. The two plants which survived the five winters were affected by frost damage on the stem tips or on the previous year's shoot.

Region 3

At Normandin, all the plants died during the first two winters.

At Kapuskasing, 5% to 10% of the plants died during the first two winters. Damage was particularly severe during the fourth winter: 50% of the plants were affected down to the level of snow cover or to ground level and 20% died.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.70 m R2 = 1.44 m R3 = 0.78 m

The growth gradient was quite distinct from one region to another.

Categories

The average height of the shrubs after five years varied from one station to another:

- 1.76 - 2.00 m: Deschambault and Sainte-Clotilde
- 1.51 - 1.75 m: L'Assomption on sand and L'Assomption on clay
- 1.26 - 1.50 m: Sainte-Foy
- 1.01 - 1.25 m: La Pocatière
- 1.00 m and - : Kapuskasing

Effect of pruning

Pruning resulted in a reduction in height of 30% to 50% every year.

Growth in width

After five years, the average width for each region was:

R1 = 0.90 m R2 = 0.95 m R3 = 0.61 m

Categories

The average width of the shrubs after five years showed little variation from one station to another:

- 1.01 - 1.25 m: Deschambault and Sainte-Clotilde
- 0.75 - 1.00 m: Sainte-Foy, L'Assomption on sand and on clay, La Pocatière and Kapuskasing

Flowering

Full flowering of this cultivar occurs on average four to six days after the flowers begin to appear. The flowers bloom around mid-June in the Montreal region, 10 days later at Sainte-Foy and at Deschambault and a week later at La Pocatière. At Kapuskasing, the flowers appear, on average, between July 6 and 10. The duration of flowering varies from 15 to 22 days but may continue for a period of 30 days.

Philadelphus X virginalis
'Minnesota Snowflake'

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and the final width obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

By the end of the first growing season, most of the shrubs had attained a height of between 50 and 100 cm at the sites in region 1 and at Deschambault. Production is therefore faster under more favourable summer conditions.

Use

The zone rating of 5 assigned by Sherk and Buckley seems conservative since the results showed little difference between the plants located in zone 5a and those in zone 4b. This cultivar can be assigned a zone rating of 4b, with the knowledge that frost damage can occur every year in zone 5 as well as in zone 4b. This frost damage is generally mild and has little effect on the subsequent growth of the plant.

It must be pointed out that this plant is more difficult to grow the first few years and should be protected the first two winters. Once the plant is established, damage is much less frequent.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 50, 86, 101, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Raynald Drapeau, Agr.

Table 1: Frequency of winter damage observed on *Philadelphus X virginalis* 'Minnesota Snowflake' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	40	52	3			3		2			60
L'Assomption-sand	62	31				7					38
Sainte-Clotilde	0	72	27			1					100
REGION 2											
Deschambault	1	52	23	19		5					99
Sainte-Foy	0	85	9	1		5					100
La Pocatière	0	2	3	5		90					100
REGION 3											
Normandin	0					100					100
Kapuskasing	0	56	27	6	4	7					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 splitting |
| 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 types 5, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Philadelphus X virginalis* 'Minnesota Snowflake' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	25	13	0	0	0	0	11	0	0	0	5	0	0	0	0										
51-100	75	75	46	18	0	100	79	16	25	0	90	10	0	0	0										
101-150	0	12	54	64	40	0	10	84	75	16	5	48	42	17	0										
151-200	0	0	0	18	60	0	0	0	0	84	0	42	58	83	100										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	45	5	0	0	0	5	6	0	0	0	90	100	67	0	0	-	-	-	-	-	95	25	0	0	25
51-100	55	70	16	18	22	90	50	0	0	0	10	0	33	100	100	-	-	-	-	-	5	75	20	80	37
101-150	0	25	84	82	33	5	44	90	18	0	-	-	-	-	-	-	-	-	-	-	0	0	80	20	38
151-200	0	0	0	0	45	0	0	10	82	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Philadelphus X virginalis* 'Minnesota Snowflake' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	30	0	9	0	0	0	11	0	0	0	58	0	0	0	0
26-50	70	25	36	18	20	76	58	50	17	17	26	37	25	0	0
51-75	0	62	55	0	10	24	31	50	75	25	16	63	50	8	0
76-100	0	13	0	73	40	0	0	0	8	50	0	0	25	75	42
101-125	0	0	0	9	10	0	0	0	0	8	0	0	0	17	58
126-150	0	0	0	0	20	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	35	0	0	0	0	24	12	0	0	0	95	80	33	0	0	-	-	-	-	-	43	5	0	10	0
26-50	55	35	0	9	0	57	25	36	0	0	5	20	67	100	0	-	-	-	-	-	57	45	10	10	38
51-75	10	45	33	9	0	19	63	64	9	0	0	0	0	0	100	-	-	-	-	-	0	50	70	30	38
76-100	0	20	58	55	67	0	0	0	82	18	-	-	-	-	-	-	-	-	-	-	0	0	20	50	24
101-125	0	0	9	27	33	0	0	0	9	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126-150	-	-	-	-	-	0	0	0	0	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Philadelphus X virginalis 'Virginal'

See colour plate

Family	:	Saxifragaceae
English name	:	Virginal mock orange
French name	:	Séringat 'Virginal'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This vigorously growing shrub can attain a height of 2.0 to 2.5 m. The long, sparse stems are upright. The bark of the young shoots is orange-brown, peeling off and becoming brown with age. The young stems are sometimes pubescent.

The large, oval leaves are 4 to 7 cm long and 2 to 4 cm wide. They are abruptly tapered and the base is rounded.

The flowers are grouped along the stem in tight clusters of four to seven large, cup-shaped flowers, 4 to 5 cm in diameter. They are white, simple or semi-double, with rounded petals and very fragrant.

ORIGIN AND DISTRIBUTION

This cultivar was developed by Victor Lemoine of Lemoines Nursery in 1909. It is a cross between *P. X lemoinei* and *P. nivalis* 'Plena'.

USE

Ornamental: All the *Philadelphus* are recommended for the beauty and abundance of their flowering. This cultivar can be used as a background plant in clumps or planting beds, and the flowers are often gathered to make bouquets. It is now less commonly used since new, more compact cultivars have become available on the market.

REQUIREMENTS

In general, the *Philadelphus* adapt to all soil types, including limestone soils and mixed fill. However, they prefer moist, well-drained soils rich in organic matter.

They must be planted in sunny locations. However, large species or cultivars flower well in clumps, provided the branch structure of the trees is not too dense.

The flower buds are formed by the fall and the plants must not be pruned before flowering. However, the plants can be cut back quite severely after flowering. Its growth is rapid and vigorous and the plants tend to lose their leaves at the base.

PATHOLOGY

To our knowledge, this cultivar does not appear to be affected by any serious disease.

PROPAGATION

Propagation by cuttings: Softwood or semi-hard cuttings are generally used to propagate this cultivar.

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 were taken on June 6, 1984 and soaked in a solution of 4,000 ppm IBA and 50% ethanol. They were placed under mist for an average duration of 30 seconds every seven minutes, in a substrate of perlite (100%). They were potted on July 8, 1984 in Fertil Pots[®] in a substrate composed of Pro-Mix[®] (50%), compost (25%) and sand (25%) and placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young plants 15 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At L'Assomption on sand, the plants suffered frost damage on the stem tips during the first and fourth winters.

At the site on clay, frost damage was somewhat more severe, affecting 25% and 17% of the plants down to the level of snow cover during the third and fourth winters. In addition, frost damage on the stem tips was observed on 100%, 83% and 42% of the plants the first and the last two winters.

At Sainte-Clotilde, frost damage on the stem tips was noted on virtually all the plants. As well, the entire previous year's shoot was damaged the third winter.

Region 2

The behaviour of the plants at Sainte-Foy was almost identical to that of the plants at Sainte-Clotilde, other than the fact that frost damage on the previous year's shoot occurred during the fourth winter on 33% of the plants.

At Deschambault, damage was more severe during the second and third winters: during the second, 72% of the plants suffered frost damage down to the level of snow cover and, during the third, 58% of the plants were affected by frost damage on the previous year's shoot. All the other plants were affected by frost damage on the stem tips.

At La Pocatière, 85% of the plants died following the first winter. We were unable to evaluate this cultivar in zone 4a because of the poor pedological conditions. However, two plants survived and exhibited damage ranging from frost damage on the tip of the branches to frost damage on the year's shoot.

Region 3

At Normandin, mortality was very high the first winter, resulting in the death of 50% of the plants. All the other plants were affected by frost damage on the stem tips or on the previous year's shoot every winter.

At Kapuskasing, only one plant died during testing. However, very severe damage affected 75% of the plants

during the fourth winter. In addition, frost damage on the previous year's shoot damaged 92% of the plants the third winter and all the plants suffered frost damage on the stem tips the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.68 m R2 = 1.29 m R3 = 0.85

The height of the plants at the three sites in region 2 was quite different from one site to another.

Categories

The average height of the shrubs after five years varied from one station to another:

1.76 m and + : Deschambault, Sainte-Clotilde and
L'Assomption on sand
1.51 - 1.75 m: -
1.26 - 1.50 m: L'Assomption on clay and Sainte-Foy
1.01 - 1.25 m: -
1.00 m and - : Kapuskasing, Normandin and La
Pocatière

At Sainte-Foy, the young shoots proved to be very fragile in high winds, resulting in a loss of growth.

Effect of pruning

Annual pruning resulted in a reduction of 20% to 50% in the total height of the plants, depending on the years and the sites.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.04 m R2 = 1.15 m R3 = 0.82 m

The plants were clearly wider in region 2, while the plants at La Pocatière brought down the regional average, which otherwise would be 1.37 m.

Philadelphus X virginialis
'Virginal'

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.26 - 1.50 m: Deschambault and Sainte-Foy
- 1.01 - 1.25 m: L'Assomption on sand and Sainte-Clotilde
- 1.00 m and - : Kapuskasing, L'Assomption on clay, La Pocatière and Normandin

At several sites (Kapuskasing, Normandin, La Pocatière and Sainte-Foy), the plants were as wide as they were high. In general, in region 1, they were higher than wide and, in region 2, only Deschambault followed this trend.

Flowering

Flowering was very constant during the last four years of testing at the sites in region 1. It began between June 15 and 21 every year. At the Sainte-Foy and Deschambault sites, flowering was more significant the last two years, as all the plants flowered at that time. The beginning of the flowering period fell between June 25 and 29, i.e. some 10 days later. At the other sites, it was scattered and sporadic.

The total duration of flowering was 20 to 44 days depending on the year, with an average of four weeks. Full flowering generally occurred five to eight days after anthesis of the first flowers.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

Plants 1.00 m high and over were obtained by the end of the second growing season at the L'Assomption on sand (86%), Sainte-Foy (62%) and Deschambault (43%) sites.

An additional year was necessary to obtain shrubs of comparable height at the other sites.

Use

The results obtained in this test tend to confirm the zone rating of 3 established previously by Buckley. In zone 2, a high percentage of plants died or were severely affected by frost damage, resulting in reduced growth and flowering. However, in zone 4b, the expression of the ornamental features of this cultivar was consistent with its potential despite mild frost damage. The high percentage of mortality at the La Pocatière site was attributable to poor edaphic conditions rather than to winter conditions.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 50, 57, 58, 86, 101, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Philadelphus X virginalis* 'Virginal' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	35	45		8					12		65
L'Assomption-sand	60	40									40
Sainte-Clotilde	7	73	20								93
REGION 2											
Deschambault	5	52	15	18				10			95
Sainte-Foy	7	86	7								93
La Pocatière	0	2	2					96			100
REGION 3											
Normandin	13	30	33			24					87
Kapuskasing	0	42	31	22	3	2					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 splitting |
| 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 types 3, 5, 9 and 14 occurred for this species.

Table 2: Breakdown of *Philadelphus X virginalis* 'Virginal' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	10	0	0	0	0	20	5	0	0	0	10	0	0	0	0										
51-100	90	14	8	0	0	80	95	67	42	8	90	48	0	0	0										
101-150	0	86	92	67	8	0	0	33	58	83	0	52	25	0	0										
151-200	0	0	0	33	92	0	0	0	0	9	0	0	75	83	75										
201-250	-	-	-	-	-	-	-	-	-	-	0	0	0	17	25										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy			Deschambault				La Pocatière			Normandin			Kapuskasing											
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90					
0-50	19	0	0	0	0	24	0	0	0	0	100	100	100	100	0	25	10	50	0	33	90	52	8	8	8
51-100	81	38	0	8	8	76	57	0	0	0	0	0	0	100	75	90	25	50	67	10	48	83	92	33	
101-150	0	62	100	92	67	0	43	75	0	0	-	-	-	-	0	0	25	50	0	0	0	9	0	59	
151-200	0	0	0	0	25	0	0	25	100	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
201-250	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3: Breakdown of *Philadelphus X virginalis* 'Virginal' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	95	0	0	0	0	81	67	25	8	0	100	0	0	0	0
51-100	5	95	58	25	25	19	33	75	92	92	0	100	33	58	25
101-150	0	5	42	75	75	0	0	0	0	8	0	0	67	42	75
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	90	0	0	0	0	76	14	0	0	0	100	100	100	100	0	95	50	50	50	33	100	52	8	8	8
51-100	10	67	25	8	0	24	86	92	50	0	0	0	0	0	100	5	50	50	50	67	0	48	92	92	50
101-150	0	33	75	92	100	0	0	8	50	91	-	-	-	-	-	-	-	-	-	-	0	0	0	0	42
151-200	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Picea pungens Engelm.

See colour plate

Family	:	Pinaceae
English name	:	Colorado spruce
French name	:	Épinette du Colorado
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree, with a conical, regular, almost columnar growth habit, can attain a height of 30 m.

The trunk is straight and the reddish-brown bark cracks very early. The long branches are spreading, slightly ascending in the upper portion of the tree and drooping in the lower portion.

The glabrous branches are yellowish-brown or orange-brown. The twigs are thin but tough; whitish to greyish-brown in colour, they have conical, pointed, scaly and sometimes resinous buds approximately 6 to 8 mm long.

The foliage ranges from dark green to bluish-green depending on the specimens. The spinulose, pointed and acuminate needles radiate at right angles from the branches. They are spirally arranged, forming a persistent, decurrent ridge at the base. The needles are 1 to 4 cm long and remain on the tree for five years or longer.

The female cones are chestnut-brown, cylindrical and are 5 to 10 cm long and 3 cm wide. Male and female cones appear on the same tree. They are composed of very thin scales with free bracts. They mature in the year of pollination, at which stage they become pendulous. The seeds are less than 4 mm long and have a terminal wing which detaches from the seed at the time of dispersal.

ORIGIN AND DISTRIBUTION

This species originates in the Rocky Mountains of the United States. It is found naturally at elevations of between 1,800 and 3,300 m, from Colorado to New

Mexico, from eastern Utah to Wyoming. It was introduced to Europe in 1862.

USE

Ornamental: It grows very quickly as a seedling but considerably more slowly thereafter. This species is used as a windbreak or standing alone when space permits and when not adversely affected by shade; otherwise the lower branches die. It is often used when needs must be met quickly. The variability of the colour of its foliage and its growth habit have led to the development of several cultivars. Its appearance does not always improve with age and it is often replaced after 25 to 30 years.

Wood use: The wood is light, soft and fairly strong but without great commercial value. It is used for lumber, mill work, plywood and for making crates and boxes. Because it is tasteless and odourless, it is ideal for packaging food products. It is also one of the best pulpwoods.

REQUIREMENTS

This species is calcifuge and prefers cool, deep soils. It is sensitive to low atmospheric humidity and is one of the spruces most resistant to pollution.

Violent gusts of wind cause the needles to fall prematurely, slowing down its growth and diminishing its esthetic value.

PATHOLOGY

Cytospora canker is caused by the fungus *Cytospora kunzei* and mainly affects the Colorado spruce and the Norway spruce.

PROPAGATION

Seedlings: The seeds do not require any pre-treatment to germinate. They can germinate at different temperatures with or without light.

Propagation by cuttings: Cuttings can be taken in winter and with proper hormone treatment, a rooting rate of 80% can be obtained after eight weeks. Most of the cultivars are grafted.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Morden, Manitoba

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: The seeds, harvested in 1980, were received on August 12, 1982; 4,000 seeds were sown on November 17 in a frame with 63% shade. On May 24, 1983, the germination rate was 8%. The young seedlings were potted in Melfert® plugs on August 22, 1984 and kept in a frame until May 28, 1985, when they were transplanted to the nursery. The survival rate was 99% the first winter and 100% the second. The seedlings were dug up on April 4, 1986, wrapped and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 12 to 14 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)**Winter damage**

Damage was very rare at the test sites, except for zone 2a, where frost damage was more severe the last three years.

Region 1

No damage was observed at Sainte-Clotilde or at the L'Assomption site on clay. At the L'Assomption site on sand, only one seedling suffered frost damage on the stem tips during the second winter.

Region 2

No frost damage occurred at Sainte-Foy or at Deschambault. At the La Pocatière site, 25% of the seedlings died during the first two winters; these plants had exhibited no growth. Another seedling died during the last winter. As well, 35% and 11% of the seedlings exhibited browning of the foliage following the first and third winters respectively.

Region 3

At Normandin, mild frost damage occurred on two seedlings during the fourth winter.

More than 80% of the seedlings at Kapuskasing did not suffer any damage the first three winters. Subsequently, half the seedlings were affected by various kinds of damage. The fourth winter, 8% of the seedlings suffered frost damage on the foliage or on the stem tips, 25% down to the level of snow cover and 8% suffered mechanical breakage. Browning of the foliage was evident on 17% to 33% of the seedlings the third and fifth winters respectively.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 84.6 cm R2 = 88.5 cm R3 = 71.8 cm

The seedlings at La Pocatière and Kapuskasing brought down their respective regional averages. Excluding these sites, the seedlings in region 2 were taller than those in the other regions.

Categories

The average height of the trees after five years varied from one station to another:

101 cm and + :	Sainte-Foy
91 - 100 cm:	Deschambault
81 - 90 cm:	L'Assomption on sand, Normandin and Sainte-Clotilde
71 - 80 cm:	L'Assomption on clay
61 - 70 cm:	-
51 - 60 cm:	Kapuskasing and La Pocatière

The poor growth observed at La Pocatière was largely due to compaction of the soil caused by heavy machinery.

Effect of pruning

No pruning was necessary for this species, except regular pruning for shaping.

***Picea pungens* Engelm.**

Growth in width

After five years, the average width of the trees for each region was:

R1 = 64.0 cm R2 = 79.3 cm R3 = 69.0 cm

The L'Assomption on clay and La Pocatière sites substantially lowered their respective regional averages.

Categories

The average width of the trees after five years varied from one station to another:

91 - 100 cm: Sainte-Foy
 81 - 90 cm: Deschambault
 71 - 80 cm: Normandin, Sainte-Clotilde and
 L'Assomption on sand
 61 - 70 cm: Kapuskasing and L'Assomption on
 clay
 51 - 60 cm: La Pocatière

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

At Sainte-Foy, Deschambault and Sainte-Clotilde, the seedlings became established more quickly. Two-thirds of the trees at Sainte-Foy attained a height of between 80 and 120 cm in four years of growth. To obtain seedlings of comparable size, a fifth year was necessary at the L'Assomption on sand, L'Assomption on clay, Sainte-Clotilde, Deschambault and Normandin sites.

This species can be produced competitively in the Montreal, Quebec City and Lac Saint-Jean regions. Growth of the trees was considerably slower on heavy soils.

Use

The results of this test indicate that the zone rating of 2, assigned previously by Sherk and Buckley (1972), can be identified more precisely as 2b. The plant is hardy as far north as zone 2b. Despite the absence of serious damage at Kapuskasing (zone 2a), the seedlings did not exceed the level of snow cover during the five-year testing period and partial results do not enable us to confirm its potential beyond this period.

Furthermore, in this zone, frost damage on the needles and the young shoots occurred when winter conditions were harsher.

BIBLIOGRAPHICAL REFERENCES

4, 14, 22, 27, 35, 47, 49, 51, 56, 72, 74, 86, 100, 101

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Picea pungens* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	100										0
L'Assomption-sand	99	1									1
Sainte-Clotilde	100										0
REGION 2											
Deschambault	98							2			2
Sainte-Foy	100										0
La Pocatière	84					7				9	16
REGION 3											
Normandin	97	3									3
Kapuskasing	76	5		5				2		12	24

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 4, 5, 7, 9 and 11 occurred for this species.

Table 2: Breakdown of *Picea pungens* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-40	100	100	50	0	0	100	100	92	17	8	100	90	33	0	0										
41-80	0	0	50	100	33	0	0	8	83	42	0	10	67	92	42										
81-120	0	0	0	0	67	0	0	0	0	50	0	0	0	8	58										
121-160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
161-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-40	100	85	8	0	0	100	95	50	0	0	100	100	100	70	22	100	95	42	0	0	100	100	75	25	0
41-80	0	15	92	33	17	0	5	50	84	25	0	0	0	30	78	0	5	58	92	50	0	0	25	75	100
81-120	0	0	0	59	41	0	0	0	16	67	-	-	-	-	-	0	0	0	8	33	-	-	-	-	-
121-160	0	0	0	8	34	0	0	0	0	8	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-
161-200	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Picea pungens* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	0	0	0	0	95	29	8	0	0	100	5	0	0	0
21-40	0	100	92	0	0	5	71	92	33	25	0	95	75	8	0
41-60	0	0	8	33	25	0	0	0	50	58	0	0	25	59	25
61-80	0	0	0	67	58	0	0	0	17	17	0	0	0	33	58
81-100	0	0	0	0	17	-	-	-	-	-	0	0	0	0	17
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskaing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	70	0	0	0	0	67	12	0	0	0	95	79	50	10	0	100	67	0	0	0	100	24	0	0	0
21-40	30	95	8	0	0	33	76	75	8	0	5	21	50	50	22	0	33	92	0	0	0	76	83	17	0
41-60	0	5	92	17	0	0	12	25	58	0	0	0	0	30	45	0	0	8	50	8	0	0	17	75	42
61-80	0	0	0	75	17	0	0	0	25	50	0	0	0	10	33	0	0	0	42	58	0	0	0	8	58
81-100	0	0	0	8	41	0	0	0	9	42	-	-	-	-	-	0	0	0	8	34	-	-	-	-	-
101-120	0	0	0	0	42	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Picea pungens 'Glauca'

See colour plate

Family	:	Pinaceae
English name	:	Colorado blue spruce
French name	:	Épinette bleue du Colorado
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree, with a conical, regular, almost columnar growth habit, can attain a height of 30 m.

The trunk is straight and the reddish-brown bark cracks very early. The long branches are spreading, slightly ascending in the upper portion of the tree and drooping in the lower portion.

The glabrous branches are yellowish-brown or orange-brown. The twigs are thin but tough; whitish to greyish-brown in colour, they have conical, pointed, scaly and sometimes resinous buds approximately 6 to 8 mm long.

The foliage of this cultivar is bluish. The spinulose, pointed and acuminate needles radiate at right angles from the branches. They are spirally arranged, forming a persistent, decurrent ridge at the base. The needles are 1 to 4 cm long and remain on the tree for five years or longer.

The female cones are chestnut-brown, cylindrical and are 5 to 10 cm long and 3 cm wide. Male and female cones appear on the same tree. They are composed of very thin scales, with free bracts. They mature in the year of pollination, at which stage they become pendulous. The seeds are less than 4 mm long and have a terminal wing which detaches from the seed at the time of dispersal.

ORIGIN AND DISTRIBUTION

This cultivar is the result of a selection of plants of the species with bluish foliage and has been used to develop several other cultivars.

USE

Ornamental: The Colorado blue spruce is highly appreciated by consumers. It is used standing alone or in groups on large sites.

REQUIREMENTS

This cultivar prefers a sunny exposure. It does better on rich, moist soils, but tolerates light, dry soils if it is well watered during the initial years of growth.

Violent gusts of wind cause the needles to fall prematurely, slowing down its growth and diminishing its esthetic value.

PATHOLOGY

Cytospora canker is caused by the fungus *Cytospora kunzei* and mainly affects the Colorado spruce and the Norway spruce.

PROPAGATION

This cultivar can be produced from seeds by selecting the specimens with bluish foliage or by grafting on *Picea pungens* or *Picea abies*.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Seeds purchased by the Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden and Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: The seeds were sown on November 1, 1981 in a frame. They germinated in the spring of 1982 and were kept in the frame until June 6, 1983. They were potted in Melfert® plugs and placed back in a frame until the spring of 1984. The young seedlings selected were transferred to L'Assomption and outplanted on June 6, 1984; they were 10 to 15 cm high. They were dug up on April 4, 1986, wrapped and placed in a cold store at 4°C until they were shipped.

Inclusion in test network: Young seedlings approximately 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Damage from browning of the needles was evident in every region.

Region 1

No damage was observed at the Sainte-Clotilde site. One seedling exhibited frost damage on the stem tips during the second winter at the L'Assomption site on sand, while 48%, 33% and 8% of the seedlings at the L'Assomption site on clay suffered damage from browning of the needles during the second, fourth and fifth winters respectively.

Region 2

No frost damage was observed at the Deschambault and Sainte-Foy sites.

At La Pocatière, 13% of the seedlings died during the second and third winters; these seedlings had exhibited no growth since planting. In addition, 72%, 24%, 25% and 10% of the seedlings exhibited browning of the foliage during the first four winters.

Region 3

At Normandin, no damage occurred during the first three winters. Following the fourth winter, 42% of the seedlings suffered frost damage on the stem tips and 8% on the previous year's shoot. The last winter, the four seedlings in the second replication died.

At Kapuskasing, frost damage on the stem tips was observed on 33%, 8% and 17% of the seedlings following the first and last two winters respectively. As well, 17% of the seedlings were affected by frost damage on the previous year's shoot the last winter and 67% by frost damage down to the level of snow cover the fourth winter. Browning of the needles was evident respectively on 75%, 8% and 58% of the seedlings the last three winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 115 cm R2 = 106 cm R3 = 96 cm

The seedlings at La Pocatière and Kapuskasing brought down their respective regional averages.

Categories

The average height of the trees after five years varied from one station to another:

121 cm and +: L'Assomption on sand, Deschambault and Normandin
 101 - 120 cm: Sainte-Clotilde and Sainte-Foy
 81 - 100 cm: L'Assomption on clay and La Pocatière
 61 - 80 cm: Kapuskasing

In general, annual growth was greater in the last two or three years.

Effect of pruning

Pruning was minimal and was limited to the stems that had suffered browning.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 86 cm R2 = 96 cm R3 = 92 cm

The seedlings at L'Assomption on clay and at La Pocatière were smaller and brought down their respective regional averages.

Categories

The average width of the trees after five years varied from one station to another:

101 cm and +: Deschambault and Sainte-Foy
 91 - 100 cm: Normandin, Sainte-Clotilde and L'Assomption on sand
 81 - 90 cm: Kapuskasing
 71 - 80 cm: La Pocatière and L'Assomption on clay

Width provides only an indicator of growth, which was variable from year to year.

Picea pungens 'Glauca'

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

Growth of this species was slow the first two years at most of the sites. However, at sites where the final height was greater, annual growth was significant by the second year. A certain percentage of seedlings at L'Assomption on sand and Deschambault attained a height of more than 1 m after four years. Similar values were obtained at Sainte-Clotilde, Sainte-Foy and Normandin after a fifth year of growth.

The seedlings at the other three sites did not exceed 1 m in height.

This species can be produced competitively in the Montreal, Quebec City and Lac Saint-Jean regions. Growth of the trees was considerably slower on heavy soils.

Use

Despite the absence of serious damage at Kapuskasing (zone 2a), the seedlings did not significantly exceed the level of snow cover during the five-year testing period and these partial results do not enable us to confirm its potential beyond this period.

The results of this test indicate that this plant is hardy as far north as zone 2b. Although there was no mortality in zone 2a, several types of frost damage and desiccation of the needles occurred on the portion of the seedlings that exceeded the level of snow cover. Therefore, the use of this cultivar cannot be recommended beyond zone 2b.

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Picea pungens* 'Glauca' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	75	8								17	25
L'Assomption-sand	99	1									1
Sainte-Clotilde	100										0
REGION 2											
Deschambault	98							2			2
Sainte-Foy	100										0
La Pocatière	70					3				27	30
REGION 3											
Normandin	84	8	2			6					16
Kapuskasing	42	12	3	13				2		28	58

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

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

Table 2: Breakdown of *Picea pungens* 'Glauca' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-50	100	52	0	0	0	100	100	75	8	0	100	33	8	0	0															
51-100	0	48	100	27	9	0	0	25	92	75	0	67	92	67	17															
101-150	0	0	0	73	54	0	0	0	0	25	0	0	0	33	75															
151-200	0	0	0	0	37	-	-	-	-	-	0	0	0	0	8															
Height (cm)	REGION 2										REGION 3																			
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	91	25	8	0	100	86	0	0	0	100	100	67	27	27	100	90	25	0	0	100	100	58	25	0					
51-100	0	9	75	83	34	0	14	100	50	17	0	0	33	73	45	0	10	75	92	8	0	0	42	75	100					
101-150	0	0	0	9	66	0	0	0	50	58	0	0	0	0	28	0	0	0	8	92	-	-	-	-	-					
151-200	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					

Table 3: Breakdown of *Picea pungens* 'Glauca' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	95	17	0	0	100	100	83	0	17	100	100	25	0	0
51-100	0	5	83	55	91	0	0	17	100	83	0	0	75	100	75
101-150	0	0	0	45	9	-	-	-	-	-	0	0	0	0	25
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy				Deschambault				La Pocatière				Normandin				Kapusking								
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90					
0-50	100	86	25	0	0	100	100	25	0	0	100	100	75	36	18	100	95	42	0	0	100	95	67	0	0
51-100	0	14	75	100	50	0	0	75	92	33	0	0	25	54	82	0	5	58	92	50	0	5	33	100	75
101-150	0	0	0	0	50	0	0	0	8	58	0	0	0	10	0	0	0	0	8	50	0	0	0	0	25
151-200	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pinus nigra 'Austriaca'

See colour plate

Family	:	Pinaceae
English name	:	Austrian pine
French name	:	Pin noir d'Autriche, pin noir, pin d'Autriche
Synonym	:	<i>Pinus nigra</i> ssp. <i>nigra</i> , <i>P.</i> <i>nigra</i> var. <i>austriaca</i> [Hoess] Neum, ssp. <i>nigricans</i> Hort., <i>Pinus nigra</i> var. <i>nigra</i> , <i>Pinus</i> <i>austriaca</i>
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This coniferous tree with a pyramidal growth habit can attain a height of 20 m and a width of 10 m; in exceptional cases, specimens 30 m tall have been recorded. The top is pyramidal and dense when the tree is young, but the crown becomes rounded or more flattened with age.

The trunk, greyish-brown to dark brown and slightly reddish in colour, has deeply furrowed bark which appears black in the shade.

The branches are spreading and almost horizontal. The branches of the year are yellowish-grey, slightly shiny and non-pubescent.

The buds are ovoid, wider than the shoot and sharply tapered at the apex. The scales are light brown and resinous.

The dark green needles, borne in bundles of two, are 8 to 14 cm long. They are thick, fairly stiff, straight, sharp and slightly incurved. However, some plants have a more glaucous colouring. The four-year leaves are perpendicular to the branch. The bundle sheaths do not exceed 16 mm in length.

The ovoid cones are yellowish-brown, becoming light brown when mature and are 5 to 8 cm long. They are solitary or in clusters of three.

The staminate strobili are yellow and occur in clusters. The pistillate strobili are greenish-yellow.

The root system is very developed and regeneration of growth after transplanting is relatively easy.

ORIGIN AND DISTRIBUTION

This pine is originally from central and southern Europe; its range covers Austria, central Italy, Greece and Yugoslavia. It can grow at elevations up to 800 m. It grows in all the regions of the Americas, with the exception of the northern and southern extremes.

This species has been cultivated since 1759.

USE

Ornamental: This species is used in clumps or standing alone. It is very tolerant of urban conditions. It is also used as a windbreak, although it has a tendency to become crooked and to lose its leaves.

Forestry: This species is used for temporary reforestation since its trunk is not always very straight. It produces good quality firewood.

Wood use: The wood is knotty.

REQUIREMENTS

This species adapts to compact clays and to limestone soils. It tolerates shallow and poor soil conditions, and is resistant to wind, pollution, lack of light and drought.

It grows quickly when young.

PATHOLOGY

No particular disease seems to affect this species under our conditions. A nematode is occasionally reported and becomes established in the root system, causing the death of the tree in a single season.

PROPAGATION

Seedlings: The seeds have no dormancy period and germination takes place immediately after seeding.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were harvested in the fall of 1982 from 20-year-old parent plants and were placed in a cold store. In May 1983, they were sown in a frame. In the summer of 1984, the seedlings were potted and cultivated in small pots. They overwintered in a frame until the spring of 1985, at which time they were shipped to the sites.

Inclusion in test network: Young seedlings 10 to 12 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Seedling mortality was reported only at Kapuskasing.

The damage most frequently observed on this species was browning of the foliage.

Region 1

No damage occurred at Sainte-Clotilde or at Sainte-Anne-de-Bellevue.

At the L'Assomption sites on sand and on clay, 40% and 75% of the seedlings suffered damage on the foliage following the last winter. As well, a few seedlings were slightly affected on the stem tips on one or two occasions.

Region 2

At Sainte-Foy and at Deschambault, the trees also suffered damage on the foliage the last two winters, affecting 25% and 60% of the seedlings depending on the year. In addition, at Sainte-Foy, damage caused by rodents was observed on 25% of the seedlings following the third winter.

At La Pocatière, partial browning of the foliage was observed on 40% of the seedlings following the second winter and on only one seedling the last winter.

Region 3

At Normandin, no damage was observed following the first three winters. Subsequently, frost damage on the previous year's shoot affected all the seedlings.

At Kapuskasing, with the exception of one seedling that died, no damage was observed following the first two winters. Subsequently, 50% of the seedlings suffered browning of the foliage the third winter, 25% of the remaining seedlings died the following winter, and the others suffered frost damage above the level of snow cover. The last winter, almost all the seedlings again suffered the same type of damage.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.33 m R2 = 1.44 m R3 = 0.91 m

The L'Assomption on clay and La Pocatière sites brought down their respective regional averages.

Categories

The average height of the trees after five years varied from one site to another:

1.51 - 1.75 m: Deschambault and Sainte-Clotilde
 1.26 - 1.50 m: Sainte-Foy, Sainte-Anne-de-Bellevue and L'Assomption on sand
 1.01 - 1.25 m: La Pocatière and L'Assomption on clay
 1.00 m and - : Normandin and Kapuskasing

Annual growth was very significant at most of the sites the last two or three years except at Kapuskasing. The seedlings located at the sites on clay exhibited less vigorous growth.

Effect of pruning

Pruning of the trees was necessary only at Normandin following the fourth winter, since the seedlings had suffered frost damage on the previous year's shoot.

Growth in width

After five years, the average width for each region was:

R1 = 1.18 m R2 = 1.26 m R3 = 0.86 m

Pinus nigra 'Austriaca'

This species generally takes two years to become well established.

Categories

The average width of the trees after five years varied from one site to another:

- 1.26 - 1.50 m: Sainte-Clotilde, Sainte-Foy and Sainte-Anne-de-Bellevue
- 1.01 - 1.25 m: Deschambault, La Pocatière and L'Assomption on sand
- 1.00 m and - : Normandin, L'Assomption on clay and Kapuskasing

The width of the trees was slightly less than or comparable to their height. During the first two years, the seedlings at Sainte-Foy were clearly wider than those at the other sites. The last three years, the trees at Sainte-Clotilde and Sainte-Foy were wider than those at several other sites.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

Regardless of the site, by the end of the second growing season, all the seedlings had attained a maximum height of 50 cm.

After a third year of growth, 80% or more of the trees at Sainte-Clotilde, Sainte-Foy and Deschambault had attained a height of between 50 cm and 1 m. This percentage varied from 10% to 60% at the other sites.

Obtaining trees with a height of 1 m or more required four years at most of the sites and it was at Deschambault that the largest number of seedlings attained this height.

Production of this species is recommended at sites in regions 1 and 2, but growth is better and faster on light, well-drained soils.

Use

This species, zoned 4 by Buckley, is slightly underestimated in terms of its hardiness; in the climatic conditions of zone 4, no serious damage was evident. However, in zone 2b, damage began to be more serious when the seedlings reached approximately 80 cm, exceeding the level of snow cover. Since there was no test site in zone 3, we cannot certify a zone rating of 3, but it would appear to be appropriate based on the results at Normandin (2b).

This species can be used on heavy soils and in a variety of climatic conditions. In zone 2, good snow coverage protects the seedlings during the initial years, but they are affected subsequently.

BIBLIOGRAPHICAL REFERENCES

3, 13, 14, 22, 23, 27, 51, 56, 60, 68

WRITTEN BY

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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Pinus nigra* 'Austriaca' from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	77	8								15	23
L'Assomption-sand	87	8	2							8	13
Ste-Anne-de-Bellevue	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	81							2		17	19
Sainte-Foy	78								5	17	22
La Pocatière	89	1								10	11
REGION 3											
Normandin	61	1	38								39
Kapuskasing	53			31		6				10	47

- ^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 splitting |
| 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 types 3, 5, 7 and 9 occurred for this species.

Table 2: Breakdown of *Pinus nigra* 'Austriaca' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	100	58	0	0	100	100	92	17	0	100	100	17	0	0	100	100	42	0	0
51-100	0	0	42	75	8	0	0	8	83	42	0	0	83	33	0	0	0	58	58	8
101-150	0	0	0	25	58	0	0	0	0	58	0	0	0	67	36	0	0	0	42	58
151-200	0	0	0	0	34	-	-	-	-	-	0	0	0	0	64	0	0	0	0	25
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	100	8	0	0	100	100	0	0	0	100	100	83	0	0	100	100	58	0	0	100	100	67	8	0
51-100	0	0	92	33	0	0	0	100	9	0	0	0	17	92	33	0	0	42	75	66	0	0	33	92	67
101-150	0	0	0	67	50	0	0	0	91	18	0	0	0	8	58	0	0	0	25	34	0	0	0	0	33
151-200	0	0	0	0	50	0	0	0	0	82	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Pinus nigra* 'Austriaca' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	100	45	17	0	0	100	95	8	0	0	100	5	0	0	0	95	24	0	0	0
26-50	0	55	58	0	0	0	5	92	25	0	0	95	8	0	0	5	76	33	0	0
51-75	0	0	25	58	0	0	0	0	75	17	0	0	58	8	0	0	0	58	8	0
76-100	0	0	0	42	50	0	0	0	0	83	0	0	34	17	8	0	0	9	50	0
101-125	0	0	0	0	50	-	-	-	-	-	0	0	0	58	0	0	0	0	42	42
126-150	-	-	-	-	-	-	-	-	-	-	0	0	0	17	50	0	0	0	0	33
151-175	-	-	-	-	-	-	-	-	-	-	0	0	0	0	33	0	0	0	0	25
176-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	43	0	0	0	0	95	33	0	0	0	100	19	0	0	0	100	10	8	0	0	100	65	25	0	0
26-50	57	76	8	0	0	5	62	17	0	0	0	81	50	0	0	0	90	84	33	0	0	35	58	25	11
51-75	0	24	58	0	0	0	5	83	8	8	0	0	50	0	0	0	0	8	42	25	0	0	17	58	22
76-100	0	0	34	33	0	0	0	0	58	0	0	0	0	100	0	0	0	0	25	75	0	0	0	17	56
101-125	0	0	0	58	0	0	0	0	34	50	0	0	0	0	92	-	-	-	-	-	0	0	0	0	11
126-150	0	0	0	9	75	0	0	0	0	42	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-
151-175	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
176-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pinus sylvestris L.

See colour plate

Family	:	Pinaceae
English name	:	Scotch pine or Scots pine
French name	:	Pin sylvestre
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree can attain a height of 30 m in its country of origin. Its growth habit is open and pyramidal on young trees, becoming asymmetrical as they get older. The top becomes thin on very old specimens.

The bark is fissured into longitudinal plates, peeling off in thin reddish-brown sheets.

The whorled, horizontal branches on the young specimens rapidly undergo a natural pruning. As they get older, the branches become crooked and the lower branches drooping. They are fine, greyish and glabrous.

The ovoid buds are long and brown, with lanceolate, white-fringed, loose-tipped scales. They are 6 to 12 mm long and are more or less resinous.

The leaves, in bundles of two, are 3 to 10 cm long. They are falcate or twisted. Their inner surface is dull green because of the conspicuous lines of stomata. The leaves are hard and persist on the tree for approximately three years. The margin is finely toothed.

The cones, composed of yellowish-brown scales, are short-stalked, subconical, symmetrical and 3 to 8 cm long. The cones are solitary or in clusters of two or three and fall when mature.

ORIGIN AND DISTRIBUTION

This species has a very large geographical distribution in Europe, being found from Spain to the Arctic circle, and from the Atlantic to Asia, with the densest concentration being found from Scotland to Siberia. Accordingly,

more than 144 sub-groups have been identified, all of which have their own particular characteristics.

USE

Ornamental: Its bluish foliage is very attractive for a tree used standing alone. In addition, the growth habit of old trees is very characteristic. The orange bark is eye-catching. This species is often used as a Christmas tree when it is young.

REQUIREMENTS

This species has the exceptional ability to adapt to all types of well-drained soils, even poor and dry soils. It grows well in slightly acidic soil. It requires a sunny exposure and adapts particularly well to urban conditions.

Regeneration of growth after transplanting is better with root ball specimens or when grown in a pot.

PATHOLOGY

The white pine weevil (*Pissodes strobi* [Peck]) is a threat in forestry for all pines and spruces.

The pine shoot beetle (*Tomicus piniperda*) is the focus of increased monitoring in order to prevent infestation in Quebec and Canada. Its usual host in the United States is the Scotch pine.

PROPAGATION

Seedlings: The seeds have no dormancy period and can be sown without stratification.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Badnor (latitude 6 degrees 40 minutes, longitude 72 degrees 45 minutes).

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: The seeds, harvested in 1971, were received on November 9, 1983. They were sterilized for 30 seconds in a solution of equal parts ethanol and Javex® (6%). After three rinsings in distilled water, they were stratified for 92 days in moist peat at 5°C and sown in a frame with 63% shade on May 9, 1984. On August 3, the germination rate was 25%. The seedlings were potted in Fertil Pots® and placed in a

frame on October 30; 94% of the seedlings survived the winter of 1984-1985. The seedlings were dug up on April 4, 1986, wrapped and kept in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 5 to 8 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Between 5% and 30% of the seedlings died the first year as a result of poor regeneration of growth after transplanting or because of mechanical breakage.

Region 1

At L'Assomption on sand, no winter damage was observed on the seedlings.

At the site on clay, no damage occurred during the first and last winters. Following the second and fourth winters, 15% and 33% of the seedlings exhibited signs of sunscald or of browning of the foliage. One seedling suffered frost damage on the stem tips during the third winter.

At Sainte-Clotilde, no damage was observed during the first four winters. The last season, 17% of the seedlings suffered mechanical breakage.

Region 2

No damage was observed at Sainte-Foy.

At Deschambault, only a few seedlings (15%) suffered browning of the foliage during the fourth winter. This type of damage was much more common at La Pocatière, affecting between 40% and 75% of the seedlings the first, third and fourth winters; 30% of the seedlings died during the first winter.

Region 3

At Normandin, 10% of the seedlings died during the first winter. Frost damage on the stem tips or on the year's shoot occurred on 37% of the seedlings during the fourth winter only. One seedling suffered mechanical breakage the last winter.

At Kapuskasing, no damage occurred during the first two winters. One seedling died the third winter. The last two winters were very difficult for this species; 42% of the seedlings suffered frost damage down to the level of snow cover the fourth winter. The following winter, 92% of the seedlings were affected: 42% suffered frost damage on the year's shoot and 50% suffered browning of the foliage.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.58 m R2 = 1.24 m R3 = 1.27 m

The La Pocatière and Kapuskasing sites brought down their respective regional averages.

Categories

The average height of the trees after five years varied from one station to another:

1.51 - 2.00 m: L'Assomption on sand, Deschambault, Sainte-Clotilde and Normandin
1.01 - 1.50 m: L'Assomption on clay and Sainte-Foy
1.00 m and - : La Pocatière and Kapuskasing

In each region, the height of the seedlings was quite variable from one site to another. The sites on clay tended to produce shorter trees.

Effect of pruning

No pruning was necessary for this species.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 1.09 m R2 = 1.21 m R3 = 1.11 m

***Pinus sylvestris* L.**

Categories

The average width of the trees after five years varied from one station to another:

- 1.26 - 1.50 m: Deschambault, L'Assomption on sand and Normandin
 1.01 - 1.25 m: Sainte-Clotilde and Sainte-Foy
 0.76 - 1.00 m: La Pocatière, Kapuskasing and L'Assomption on clay

In general, the seedlings in region 1 were higher than they were wide, while those in regions 2 and 3 were often as wide as they were high.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This species exhibited significant variability between individuals grown from the same seed source; in general, the height of 20% of the seedlings was significantly lower than the average obtained at each site. This distribution is clearly visible in Table 2.

It took four years of growth for 60% to 75% of the seedlings to attain a height greater than 1 m at the L'Assomption on sand, Sainte-Clotilde, Deschambault and Normandin sites. At the L'Assomption site on clay and at Sainte-Foy, a fifth year was necessary. Under good conditions, the production of this species seems to be comparable in regions 1 and 2, taking into account the fact that the growth of a certain percentage of seedlings will always be delayed compared to the average growth of all the seedlings.

Use

This species is assigned a zone rating of 2 according to Buckley and the American USDA system. Based on the results of this test, this rating can be defined more precisely as 2b, since in zone 2a the survival of the plant

was not necessarily affected, although the young seedlings occasionally suffered fairly severe frost damage. This frost damage can affect the ornamental appearance of the species. In forestry, this type of frost damage does not seem to limit the establishment of this species in zone 2a.

BIBLIOGRAPHICAL REFERENCES

4, 13, 14, 22, 27, 44, 49, 51, 56, 65, 72, 77, 86, 100, 101

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Pinus sylvestris* from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	89	2					3			6	11
L'Assomption-sand	100										0
Sainte-Clotilde	96							4			4
REGION 2											
Deschambault	97									3	3
Sainte-Foy	100										0
La Pocatière	62					6				32	38
REGION 3											
Normandin	89	5	2			2		2			11
Kapuskasing	73		8	8		1				10	27

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 5, 7 and 11 occurred for this species.

Table 2: Breakdown of *Pinus sylvestris* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	100	93	0	0	0	100	100	42	8	0	100	100	33	8	0										
51-100	0	7	89	22	0	0	0	58	59	25	0	0	67	17	8										
101-150	0	0	11	56	34	0	0	0	33	42	0	0	0	75	33										
151-200	0	0	0	22	44	0	0	0	0	25	0	0	0	0	50										
201-250	0	0	0	0	0	0	0	0	0	8	0	0	0	0	9										
251-300	0	0	0	0	22	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	100	83	17	8	100	100	14	0	0	100	100	100	37	12	100	100	36	0	0	100	100	67	8	0
51-100	0	0	17	67	17	0	0	86	29	0	0	0	0	63	75	0	0	64	36	0	0	0	33	83	83
101-150	0	0	0	8	67	0	0	0	71	28	0	0	0	0	13	0	0	0	64	36	0	0	0	9	17
151-200	0	0	0	8	8	0	0	0	0	29	-	-	-	-	-	0	0	0	0	55	-	-	-	-	-
201-250	-	-	-	-	-	0	0	0	0	43	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Pinus sylvestris* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	100	0	0	0	100	100	75	9	25	100	100	17	8	0
51-75	0	0	89	0	0	0	0	25	33	25	0	0	75	0	8
76-100	0	0	11	33	11	0	0	0	33	17	0	0	8	42	8
101-125	0	0	0	56	33	0	0	0	17	33	0	0	0	50	25
126-150	0	0	0	11	33	0	0	0	8	0	0	0	0	0	50
151-175	0	0	0	0	23	-	-	-	-	-	0	0	0	0	9
176-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	100	50	8	0	100	NA	14	0	0	100	100	100	13	0	100	100	45	0	0	100	100	83	0	0
51-75	0	0	50	42	8	0	NA	86	28	0	0	0	0	87	12	0	0	45	9	0	0	0	17	92	8
76-100	0	0	0	33	8	0	NA	0	29	14	0	0	0	0	50	0	0	10	73	0	0	0	0	8	83
101-125	0	0	0	17	59	0	NA	0	43	14	0	0	0	0	38	0	0	0	18	54	0	0	0	0	9
126-150	0	0	0	0	8	0	NA	0	0	29	-	-	-	-	-	0	0	0	0	18	-	-	-	-	-
151-175	0	0	0	0	17	0	NA	0	0	14	-	-	-	-	-	0	0	0	0	28	-	-	-	-	-
176-200	-	-	-	-	-	0	NA	0	0	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Potentilla fruticosa 'Abbotswood'

See colour plate

Family	:	Rosaceae
English name	:	Abbotswood cinquefoil
French name	:	Potentille frutescente 'Abbotswood'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This small shrub with a globular, wide and spreading growth habit reportedly does not exceed a height of 75 cm according to the literature. However, in this test, the plants attained a height of 1.05 m and a width of up to 1.30 m.

The foliage is bluish-green. The leaves are trifoliate and sessile. They range in shape from elliptic to oblong-linear. They are 1 to 3 cm long. The margin is involute.

The flowers are white. Flowering is recurrent and the flowers appear until the first fall frosts.

ORIGIN AND DISTRIBUTION

This cultivar was developed around 1965.

USE

Ornamental: This cultivar can be used standing alone or in clumps.

REQUIREMENTS

This cultivar is intolerant of de-icing salt. It must be pruned and rejuvenated regularly.

PATHOLOGY

Although relatively resistant to diseases and insects, the potentillas can exhibit various types of spots as well as

powdery mildew on the foliage. Occasionally, the plants are attacked by acarids.

PROPAGATION

Propagation by cuttings: Propagation of this cultivar is generally by semi-hard cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation site: Agriculture and Agri-Food Canada research farm, L'Assomption, Quebec

Propagation technique: 300 cuttings of 10 cm were taken on July 3, 1984 from four-year-old parent plants 40 cm high and 50 cm wide. They were soaked in a solution of 5,000 ppm IBA and 50% ethanol. They were placed in a mist propagator in a substrate composed of peat (50%) and perlite (50%). The rooting rate was 90% after three weeks. The plants were potted in Fertil Pots[®] on July 25 and overwintered in a frame. On May 28, 1985, they were transplanted to a planting bed. The survival rate the second winter was 99%. The plants were dug up on May 4, 1986, wrapped and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young plants 12 to 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

Damage was observed at Sainte-Clotilde and at L'Assomption on sand following one winter out of five. At the latter site, the plants exhibited signs of frost damage on the stem tips the third winter, while at the site on clay, this type of frost damage was apparent the third and fifth winters on 33% and 100% of the plants respectively.

Region 2

At Sainte-Foy, only one plant exhibited frost damage on the stem tips the last winter.

At the Deschambault site, breakage caused by the weight of snow or ice damaged 75%, 100% and 50% of the plants the last three winters.

At the La Pocatière site, the mortality observed was due to the poor pedological conditions of the plot. However, the plants which survived suffered fairly extensive damage during the first and last winters; frost damage on the stem tips, frost damage on the previous year's shoot and some mortality were the main damage. In general, 40% to 83% of the plants exhibited no damage the first four winters.

Region 3

At Normandin, no damage occurred during the second and third winters. Frost damage on the stem tips was observed on 67%, 33% and 100% of the plants the other winters and frost damage on the previous year's shoot on 67% of the plants during the fourth winter.

At Kapuskasing, no frost damage affected the plants. However, 33% of the plants suffered mechanical breakage during the fourth winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.82 m R2 = 0.72 m R3 = 0.80 m

The La Pocatière site brought down the average for region 2.

Categories

The average height of the shrubs after five years showed little variation from one station to another:

0.81 - 1.00 m: Sainte-Clotilde, Deschambault, Normandin, L'Assomption on sand and Sainte-Foy
 0.61 - 0.80 m: Kapuskasing and L'Assomption on clay
 0.41 - 0.60 m: La Pocatière

In general, this cultivar displayed quite vigorous growth at all the sites, although growth was slower on clay soils.

Effect of pruning

At certain sites, slight pruning for rejuvenation was necessary when the plants became too large.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.96 m R2 = 0.98 m R3 = 1.10 m

The L'Assomption on clay and La Pocatière sites brought down their respective regional averages.

Categories

The average width of the shrubs after five years varied from one station to another:

1.21 m and + : Deschambault and Normandin
 1.01 - 1.20 m: Sainte-Clotilde, L'Assomption on sand and Sainte-Foy
 0.81 - 1.00 m: Kapuskasing
 0.61 - 0.80 m: La Pocatière and L'Assomption on clay

Flowering

This cultivar began to flower between May 24 and early June in the Montreal region, while in the Quebec City region, the first flowers appeared mainly around June 6 or 8. At Normandin and Kapuskasing, the beginning of the flowering period fell between June 7 and 14.

The total flowering period lasted about 150 days in the Montreal region, from 130 to 140 days in the Quebec City region and 120 days at Normandin and Kapuskasing. In general, full flowering occurred 10 to 15 days after the beginning of flowering.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Potentilla fruticosa* 'Abbotswood' ...*Production**

By the end of the first growing season, 80% or more of the plants had attained a height of between 26 and 50 cm, except those at Kapuskasing and La Pocatière. It is therefore possible to produce this cultivar wherever the pedological conditions permit. In addition, the height and width of the plants increased little after the third year of growth.

Use

In the American literature, the zone rating of *Potentilla fruticosa* is 2 (USDA). However, our test results clearly demonstrate that this cultivar is hardy in zone 2a and could even grow without problems in zone 1b since Kapuskasing is at the northernmost limit of the climatic conditions prevailing in this zone.

The test results demonstrate that the zoning established by Sherk and Buckley (zone 2) for the species is suited to the potential of this cultivar. The winter damage observed in the most northerly zone of Kapuskasing (2a) was no greater than that observed at the other sites. Since damage was very light in zone 2a, it is probable, with reservations, that this plant would be hardy in zone 1b.

BIBLIOGRAPHICAL REFERENCES

4, 27, 50, 57, 86

WRITTEN BY

Claude Richer, Agr.
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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Potentilla fruticosa* 'Abbotswood' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	73	27								27
L'Assomption-sand	80	20								20
Sainte-Clotilde	100									0
REGION 2										
Deschambault	44							56		56
Sainte-Foy	98	2								2
La Pocatière	58	26	7			8	1			42
REGION 3										
Normandin	47	40	13							53
Kapuskasing	92							8		8

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 6, 7, 9 and 11 occurred for this species.

Table 2: Breakdown of *Potentilla fruticosa* 'Abbotswood' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-25	19	0	0	0	0	14	0	0	0	0	0	0	0	0	0															
26-50	81	76	0	0	0	86	72	17	25	17	100	0	0	0	0															
51-75	0	24	67	0	8	0	28	83	67	83	0	100	17	0	0															
76-100	0	0	33	100	92	0	0	0	8	0	0	0	83	100	83															
101-125	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17															
Height (cm)	REGION 2										REGION 3																			
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	5	0	0	0	0	10	0	0	0	0	100	0	0	0	0	14	0	0	0	0	67	0	0	0	0	67	0	0	0	0
26-50	95	30	0	0	8	86	14	8	0	0	0	100	33	67	50	86	29	0	0	0	33	56	8	8	8	33	56	8	8	8
51-75	0	70	83	17	83	4	76	34	33	17	0	0	67	33	50	0	71	50	42	0	0	44	92	75	34	0	44	92	75	34
76-100	0	0	17	83	9	0	10	58	67	67	-	-	-	-	-	0	0	50	58	100	0	0	0	17	58	0	0	0	17	58
101-125	-	-	-	-	-	0	0	0	0	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3: Breakdown of *Potentilla fruticosa* 'Abbotswood' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-50	81	0	0	0	0	14	0	0	0	25	57	0	0	0	0
51-75	19	9	8	8	0	86	100	67	67	50	43	0	0	0	0
76-100	0	71	50	17	33	0	0	33	33	25	0	100	33	67	33
101-125	0	20	42	50	59	-	-	-	-	-	0	0	67	33	34
126-150	0	0	0	25	8	-	-	-	-	-	0	0	0	0	33

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	0	0	0	0	0	38	5	0	0	0	0	0	0	0	0	5	0	0	0	0
26-50	40	0	0	0	0	33	5	0	0	0	62	79	17	17	17	62	0	0	0	0	78	0	0	0	0
51-75	60	5	0	0	0	67	62	33	0	0	0	16	83	67	50	38	14	0	0	0	17	61	8	8	17
76-100	0	90	58	75	58	0	33	42	58	33	0	0	0	16	33	0	71	17	33	0	0	39	92	67	33
101-125	0	5	42	25	42	0	0	25	42	17	-	-	-	-	-	0	15	83	59	58	0	0	0	25	42
126-150	-	-	-	-	-	0	0	0	0	50	-	-	-	-	-	0	0	0	8	42	0	0	0	0	8

Potentilla fruticosa 'Daydawn'

See colour plate

Family	:	Rosaceae
English name	:	Daydawn cinquefoil
French name	:	Potentille frutescente 'Daydawn'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This small shrub, with a globular, wide and spreading growth habit, can attain a height of 1.20 m and a slightly greater width.

The foliage is medium green. The leaves are trifoliate and sessile. They are oblong-linear or elliptic and are 1 to 3 cm long. The margin is involute.

The colouring of the flowers ranges from cream to salmon to peach. All the references agree that the colouring depends on the summer temperatures and the amount of sun exposure.

ORIGIN AND DISTRIBUTION

This cultivar was selected around 1984 and is the result of a mutation of the 'Tangerine' cultivar.

USE

Ornamental: This cultivar is used standing alone or in clumps.

REQUIREMENTS

The plants must be pruned and rejuvenated regularly.

PATHOLOGY

Although relatively resistant to diseases and insects, the potentillas can exhibit various types of spots as well as powdery mildew on the foliage. Occasionally, the plants are attacked by acarids.

PROPAGATION

Propagation by cuttings: Propagation of this cultivar is normally by semi-hard cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 540 cuttings of 10 cm were taken on July 3, 1985 from four-year-old parent plants 40 cm high and 50 cm wide. The cuttings were soaked in a solution of 5,000 ppm IBA and 50% ethanol. They were placed in a mist propagator in a substrate composed of peat (50%) and perlite (50%). The rooting rate was 96% after three weeks. The plants were potted in Fertal Pots[®] on July 25 and placed in a frame. On April 3, 1986, they were wrapped and kept in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young plants 13 to 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, frost damage on the stem tips occurred on 67% of the plants during the third winter.

At the L'Assomption site on clay, damage was more common, with 100% and 80% of the plants having suffered damage during the third and fifth winters respectively. In addition, during the last two winters, 17% and 10% of the plants died and 25% and 100% of the plants were damaged by rodents.

No damage occurred at Sainte-Clotilde.

Region 2

No frost damage affected the plants located at Sainte-Foy. Only damage caused by rodents was observed following the third winter.

At Deschambault, 75% and 67% of the plants suffered mechanical breakage during the third and fourth winters.

At La Pocatière, despite unfavourable pedological conditions, only one plant had died by the end of testing. In general, 70% or more of the plants exhibited frost damage on the stem tips during the last four winters. In addition, following the third winter, the previous year's shoot was destroyed on 30% of the plants.

Region 3

At Normandin, frost damage on the stem tips affected 67% and 100% of the plants during the first and last winters and 83% of the plants exhibited frost damage on the previous year's shoot the fourth winter.

At Kapuskasing, only one plant died and two others were damaged by the snow the fourth winter. No other damage affected this cultivar.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.70 m R2 = 0.58 m R3 = 0.69 m

The height of the plants was quite comparable at the three sites in region 1 as well as at the two sites in region 3.

Categories

The average height of the shrubs after five years varied very little from one station to another:

0.76 m and + : Sainte-Clotilde and Deschambault
 0.51 - 0.75 m: Kapuskasing, L'Assomption on sand,
 Normandin and L'Assomption on clay
 0.26 - 0.50 m: La Pocatière and Sainte-Foy

At the Sainte-Foy site, the plants had to be cut back close to the ground following the last two winters because of damage caused by field mice. At La Pocatière, the pedological conditions of the plot were unfavourable for this cultivar.

Effect of pruning

The last two years, spring pruning often resulted in a reduction of the total height of approximately 20% to 30%.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.83 m R2 = 0.89 m R3 = 1.10 m

At all the sites, the plants were wider than they were high, and this was particularly evident at the sites in region 3.

Categories

The average width of the shrubs after five years varied from one station to another:

1.01 m and + : Kapuskasing, Deschambault,
 Normandin and Sainte-Clotilde
 0.81 - 1.00 m: L'Assomption on sand and La
 Pocatière
 0.80 m and - : Sainte-Foy and L'Assomption on clay

Clay soils do not seem to affect the growth of this potentilla.

Flowering

The duration of the flowering period of this cultivar was approximately 100 to 150 days, depending on how early spring began. In region 1, the first flowers appeared between May 25 and June 15. The plants at Deschambault and La Pocatière also began to flower around June 15. At Normandin and Kapuskasing, there was greater variation in the date that flowers appeared, ranging from June 13 to August 3, depending on the year and the pruning done.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Potentilla fruticosa* 'Daydawn'*Production**

All the plants at Sainte-Clotilde and 86% of the plants at Deschambault were between 51 and 75 cm high after two years of growth. At the other sites, an additional year was necessary to obtain plants of comparable size.

This cultivar can be produced in all regions of Quebec, without restriction.

Use

This cultivar is perfectly adapted to the climatic regions corresponding to zone 2a, since winter damage there was almost nil. A zone rating of 2a is entirely justified for this cultivar and could probably be extended to 1b.

This cultivar had to be rejuvenated from the third year onward to improve its appearance. It grew quite well in well-drained heavy soils.

BIBLIOGRAPHICAL REFERENCES

4, 27, 49, 50, 57

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Potentilla fruticosa* 'Daydawn' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	52	36				5			7		48
L'Assomption-sand	87	13									13
Sainte-Clotilde	100										0
REGION 2											
Deschambault	65							35			35
Sainte-Foy	80								20		20
La Pocatière	32	57	8			2	1				68
REGION 3											
Normandin	50	33	17								50
Kapuskasing	95					2		3			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 splitting |
| 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 types 3, 6, 7, 9 and 14 occurred for this species.

Table 2: Breakdown of *Potentilla fruticosa* 'Daydawn' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-25	45	0	0	0	0	29	0	0	0	0	14	0	0	0	0															
26-50	55	85	8	0	0	71	100	42	17	11	86	0	0	0	0															
51-75	0	15	84	67	67	0	0	58	75	89	0	100	75	58	42															
76-100	0	0	8	33	33	0	0	0	8	0	0	0	25	42	58															
Height (cm)	REGION 2															REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90					
0-25	24	5	0	0	8	29	0	0	0	0	100	0	0	8	8	62	0	0	0	0	81	0	0	0	0					
26-50	76	95	8	8	50	71	14	0	0	8	0	100	50	33	42	38	67	8	25	0	19	72	25	17	0					
51-75	0	0	92	92	42	0	86	67	83	25	0	0	50	59	50	0	33	83	67	100	0	28	75	83	64					
76-100	-	-	-	-	-	0	0	33	17	67	-	-	-	-	-	0	0	9	8	0	0	0	0	0	36					

Table 3: Breakdown of *Potentilla fruticosa* 'Daydawn' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	76	14	0	0	22	76	0	0	0	0
51-100	0	100	75	100	92	24	86	100	100	78	24	100	8	50	33
101 and +	0	0	25	0	8	-	-	-	-	-	0	0	92	50	67

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskaing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	76	0	0	8	17	86	0	0	0	0	100	52	8	8	8	100	0	0	0	0	95	10	0	0	0
51-100	24	100	0	92	83	14	100	100	67	17	0	48	92	92	83	0	100	25	67	33	5	90	100	83	10
101 and +	0	0	100	0	0	0	0	0	33	83	0	0	0	0	9	0	0	75	33	67	0	0	0	17	90

Potentilla fruticosa 'Snowflake'

See colour plate

Family	:	Rosaceae
English name	:	Snowflake cinquefoil
French name	:	Potentille frutescente 'Snowflake'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This small shrub, with a globular, wide and spreading growth habit, can attain a height of 1.50 m and a slightly greater width.

The foliage is dark green and glossy. The leaves are trifoliate and sessile. They are wide, oblong or elliptic and are 1 to 3 cm long. The margin is involute.

The white, semi-double flowers are approximately 2.5 cm in diameter. After the first intense period of flowering, flowers reappear sporadically until the first fall frosts. The dried sepals remain on the plant.

ORIGIN AND DISTRIBUTION

This cultivar is the result of a selection.

USE

Ornamental: This cultivar can be used standing alone, as a hedge or in clumps.

REQUIREMENTS

Since this cultivar is intolerant of de-icing salt, it must not be used along roadsides.

The plants must be pruned and rejuvenated regularly.

PATHOLOGY

Although relatively resistant to insects and diseases, the potentillas can exhibit various types of spots and powdery mildew on the foliage. Occasionally, this species is attacked by acarids.

PROPAGATION

Propagation by cuttings: Propagation of this cultivar is normally by semi-hard cuttings.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 450 cuttings of 10 cm were taken on July 3, 1985 from five-year-old parent plants 30 cm high and 40 cm wide. They were soaked in a solution of 5,000 ppm IBA and 50% ethanol. They were placed in a mist propagator in a substrate composed of peat (50%) and perlite (50%). The rooting rate was 97% after three weeks. The plants were potted in Fertil Pots[®] on July 25 and placed in a frame. The winter survival rate was 99%. They were dug up on April 3, 1986, wrapped and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young plants 11 to 13 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, frost damage on the stem tips was observed following the third winter only.

At the L'Assomption site on clay, no plants were damaged during the first two winters, with the exception of one plant that died during the second winter. Subsequently, they were extensively affected by frost damage on the stem tips.

At Sainte-Clotilde, 33% of the plants exhibited signs of frost damage on the stem tips following the second and fourth winters. No other damage was observed.

Region 2

At Sainte-Foy, the damage observed was caused by field mice, which gnawed 100% and 56% of the plants during the third and fourth winters; 25% of the plants gnawed during the third winter subsequently died.

At Deschambault, most of the plants were damaged by the weight of the snow the last three winters.

At La Pocatière, no damage occurred during the first and third winters. The fourth and fifth winters, the plants were affected by various types of frost damage: 17% and 50% of the plants suffered damage on the stem tips, 8% and 37% of the plants exhibited signs of frost damage on the previous year's shoot and 33% and 12% of the plants died.

Region 3

At Normandin, all the plants suffered frost damage on the stem tips during the first and last winters. The fourth winter, one plant died and all the other plants were affected by frost damage on the previous year's shoot.

At Kapuskasing, there was little frost damage. One plant died during the first winter and another the last winter. In addition, 92% of the plants suffered mechanical breakage the fourth winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.90 m R2 = 0.78 m R3 = 0.87 m

There was no difference between the regions. The Sainte-Foy site brought down the average for region 2.

Categories

The average height of the shrubs after five years varied from one station to another:

0.76 - 1.00 m: Sainte-Clotilde, L'Assomption on sand, Deschambault, Normandin and Kapuskasing

0.50 - 0.75 m: La Pocatière, L'Assomption on clay and Sainte-Foy

Effect of pruning

Pruning resulted in a reduction in the height of the plants of approximately 30% to 50% every year. The reduction was greater in the case of damage caused by field mice or mechanical breakage.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.88 m R2 = 0.82 m R3 = 0.96 m

The maximum width was attained by the end of the third year of growth except at the sites in region 3, where it increased throughout the testing period.

Categories

The average width of the shrubs after five years varied from one station to another:

1.01 m and + : Sainte-Clotilde and Kapuskasing

0.76 - 1.00 m: L'Assomption on sand, Deschambault, Normandin and La Pocatière

0.51 - 0.75 m: Sainte-Foy and L'Assomption on clay

Damage caused by field mice severely reduced the width of the plants at Sainte-Foy.

Flowering

The duration of the flowering period of this cultivar was approximately 100 to 140 days. In region 1, the first flowers appeared between May 30 and June 14. The plants in region 2 also began to flower around June 14. At Normandin and Kapuskasing, the first flowers were observed between June 14 and 26, depending on the year.

***Potentilla fruticosa* 'Snowflake' ...**

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This cultivar of potentilla is very fast-growing. By the end of the second year of growth, all the plants at the L'Assomption on sand, Sainte-Clotilde, Sainte-Foy and Deschambault sites, as well as 80% or more of the plants at Normandin and Kapuskasing, were between 50 and 100 cm high. The production of this plant is possible throughout Quebec. However, excessively heavy soils and sites likely to harbour field mice should be avoided. Since this is a very fast-growing cultivar, it is possible to grow it within a two-year period.

Use

The test results demonstrated that the zoning established by Sherk and Buckley for all potentillas (zone 2) is suited to the potential of this cultivar in light of the fact that winter damage was very minor in zone 2a. Growth in zone 2a was comparable to that in zone 5. This cultivar is more likely to be damaged by field mice than the 'Abbotswood' cultivar. In addition, the damage observed was somewhat more serious than that observed on the 'Daydawn' cultivar. Likewise, it seems somewhat more vulnerable to damage caused by the weight of snow or ice than the above-mentioned cultivars.

BIBLIOGRAPHICAL REFERENCES

4, 27, 57, 86, 101

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Potentilla fruticosa* 'Snowflake' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage							Cumulative damage	
		WINTER DAMAGE ^a								
	1	2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	52	47				1				48
L'Assomption-sand	80	20								20
Sainte-Clotilde	87	13								13
REGION 2										
Deschambault	31							67	2	69
Sainte-Foy	69					5			26	31
La Pocatière	49	34	8			9				51
REGION 3										
Normandin	40	40	18			2				60
Kapuskasing	75					2		23		25

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 5, 6, 7 and 9 occurred for this species.

Table 2: Breakdown of *Potentilla fruticosa* 'Snowflake' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-25	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0										
26-50	95	24	0	0	0	95	43	0	0	8	100	5	0	0	0										
51-75	0	76	42	0	0	0	57	83	75	50	0	0	8	0	0										
76-100	0	0	58	92	75	0	0	17	25	42	0	95	75	92	58										
101-125	0	0	0	8	25	-	-	-	-	-	0	0	17	8	42										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	5	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-50	90	5	0	11	22	95	0	0	8	0	62	71	17	11	0	100	5	0	0	0	95	15	0	0	8
51-75	10	95	17	89	78	0	95	33	8	8	0	29	75	56	62	0	95	42	33	18	5	85	50	33	8
76-100	0	0	83	0	0	0	5	67	84	67	0	0	8	33	38	0	0	58	67	64	0	0	50	67	67
101-125	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	0	0	0	0	18	5	0	0	0	17

Table 3: Breakdown of *Potentilla fruticosa* 'Snowflake' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	10	0	0	0	0	5	0	0	0	0	0	0	0	0	0
26-50	90	0	0	0	0	95	76	0	0	42	100	0	0	0	0
51-75	0	57	25	0	8	0	24	75	50	42	0	5	0	0	0
76-100	0	43	67	58	67	0	0	25	42	16	0	95	17	58	25
101-125	0	0	8	42	25	0	0	0	8	0	0	0	83	42	75
126 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	5	0	0	0	0	33	0	0	0	0	52	9	0	0	0	40	0	0	0	0	5	0	0	0	0
26-50	80	0	0	22	11	67	0	0	8	0	48	38	17	12	0	60	10	0	0	0	95	20	0	0	8
51-75	15	65	25	67	67	0	85	25	17	8	0	53	75	44	25	0	55	25	50	27	0	55	17	8	8
76-100	0	35	67	11	22	0	15	75	67	58	0	0	8	44	50	0	35	58	50	45	0	25	83	25	17
101-125	0	0	8	0	0	0	0	0	8	34	0	0	0	0	25	0	0	17	0	28	0	0	0	67	50
126 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17

Prunus padus L.

See colour plate

Family	:	Rosaceae
English name	:	European bird cherry
French name	:	Cerisier à grappes or merisier à grappes
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This small tree can attain a height of 9 to 12 m and a width of 6 m.

Leafing is very early: this is one of the first trees to be covered with leaves in the spring. The leaves are green on the upper surface and greyish beneath.

The small white flowers, which smell like almonds, occur in drooping or spreading clusters, approximately 7 to 8 cm long, and sometimes as long as 15 cm. They appear in the spring, after the leaves, and are followed by small, bitter, black fruits in July and August.

ORIGIN AND DISTRIBUTION

This species is originally from central and northern Europe, western Asia and Morocco. It was introduced in 1758.

USE

Ornamental: Although it can grow to the size of a tree in the most temperate regions, this cherry is used as a large shrub on the Prairies, where it grows to a height of 7 m. According to some authors, it is under-used; however, its cultivars are more attractive and do not flower so early.

REQUIREMENTS

This small tree, whose flowers and growth habit are very decorative, prefers well-drained soils, and it can be deformed by winter winds.

PATHOLOGY

Black knot disease has limited the use of this species. However, it seems less susceptible to the attacks of caterpillars than *Prunus virginiana*.

PROPAGATION

Seedlings: The fruits are harvested when quite ripe. They are then carefully crushed, piled and regularly stirred to avoid any overheating caused by the beginning of fermentation. Next, the seeds are gathered, washed and stratified.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden

Propagation site: Montreal Botanical Garden

Propagation technique: Cuttings of 25 cm were taken on June 18, 1984. They were treated with a solution of 4,000 ppm IBA, placed in perlite and subjected to mist at a frequency of 30 seconds every seven minutes. The plants overwintered in a frame until they were shipped in the spring of 1985.

Inclusion in test network: Plants 15 to 20 cm high and 2 to 3 mm in diameter were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Very few plants died during testing and the damage observed was limited to frost damage on the stem tips.

Region 1

Only one plant died during the first winter, at L'Assomption on sand, and this damage could be related to poor regeneration of growth of the plant. No other winter damage occurred at the L'Assomption and Sainte-Clotilde sites.

At Sainte-Anne-de-Bellevue, slight damage was observed the first two winters on 24% and 5% of the plants, respectively. In addition, 29% of the plants at this site suffered damage caused by rodents during the first year.

Region 2

At Deschambault, one or two plants died during the first, third and fourth winters. No damage was observed on the other plants.

No damage was observed at La Pocatière during the five years of testing.

At Sainte-Foy, as at Sainte-Anne-de-Bellevue, mild frost damage occurred the first two winters and only one plant suffered mechanical breakage during the third winter.

Region 3

Virtually all the plants at Normandin and Kapuskasing suffered no damage during the five years of testing.

At Normandin, only one plant suffered frost damage on the stem tip the last year.

At Kapuskasing, a few plants died following the first winter and certain others suffered breakage the last winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 3.32 m R2 = 2.63 m R3 = 2.97 m

Categories

The average height of the trees after five years varied from one site to another:

3.51 m and + : Sainte-Clotilde, Normandin and L'Assomption on sand
 3.01 - 3.50 m: Deschambault and Sainte-Anne-de-Bellevue
 2.51 - 2.75 m: Sainte-Foy and L'Assomption on clay
 2.26 - 2.50 m: Kapuskasing
 2.01 - 2.25 m: La Pocatière

Growth was quite heterogeneous between the sites in the same region, which may explain the lower average in region 2: the plants at La Pocatière were clearly smaller than those at Deschambault and Sainte-Foy, and those at Normandin were significantly taller than those at Kapuskasing.

Effect of pruning

The new shoots of the year are easily broken by the wind, which made severe pruning necessary, particularly at Sainte-Foy.

Growth of trunk diameter

After five years, the trunk diameter for each region was:

R1 = 54 mm R2 = 46 mm R3 = 43 mm

Growth in trunk diameter was clearly greater in region 1.

Categories

The average diameter of the trees after five years varied significantly from one site to another:

51 - 60 mm: Sainte-Anne-de-Bellevue, Sainte-Clotilde, Deschambault, L'Assomption on sand and L'Assomption on clay
 41 - 50 mm: Normandin
 31 - 40 mm: Kapuskasing and Sainte-Foy

Note: Data were not available for the last year at La Pocatière, but the average trunk diameter of the trees after the fourth year was similar to that at Normandin.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and the trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

Sainte-Anne-de-Bellevue is the only site where 42% of the trees had attained a diameter of between 41 and 50 mm after three years of growth. It took an additional year for the trees at the Sainte-Clotilde, Deschambault and L'Assomption on sand sites to produce a similar diameter, in proportions of 83%, 46% and 25% respectively.

At Normandin and L'Assomption on clay, respectively 70% and 80% of the trees had a diameter greater than 40 mm after five years of growth.

***Prunus padus* L.**

To obtain trees 2.50 m high or taller, it took on average four years of growth at L'Assomption on sand, Sainte-Clotilde, Sainte-Anne-de-Bellevue, Deschambault and Normandin. At the other sites, an additional year was required.

The height of the trees leads to slightly different conclusions than those that can be drawn from diameter: it was the Sainte-Foy and Sainte-Anne-de-Bellevue sites that had the tallest trees after two years.

In light of the results obtained, zone 5b is best suited for the production of this cherry since the trees at Sainte-Anne-de-Bellevue had a greater trunk diameter than those at the other sites by the second year. However, it is recommended throughout the Montreal region and at production sites similar to the Deschambault site.

Use

The zone rating of 2, assigned by Sherk and Buckley, is slightly underestimated since winter damage was minimal at all the sites. This species can be used throughout Quebec, and quite probably as far north as zone 1b, without winter protection.

However, it is necessary to choose a site protected from the wind in order to avoid breakage of the young shoots and deformation of the crown.

BIBLIOGRAPHICAL REFERENCES

3, 23, 46, 57, 60, 86, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Prunus padus* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	100									0
L'Assomption-sand	99					1				1
Ste-Anne-de-Bellevue	88	6							6	12
Sainte-Clotilde	100									0
REGION 2										
Deschambault	91					9				9
Sainte-Foy	83	15						2		17
La Pocatière	100									0
REGION 3										
Normandin	98	2								2
Kapuskasing	94					3		3		6

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3 to 7 and 9 occurred in this species.

Table 2: Breakdown of *Prunus padus* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	100	26	0	0	0	70	0	0	0	0	100	5	0	0	0	57	10	0	0	0					
11-20	0	42	8	0	0	30	75	0	0	0	0	76	8	0	0	43	14	8	8	0					
21-30	0	32	42	8	0	0	25	75	17	9	0	19	50	0	0	0	62	25	17	25					
31-40	0	0	42	67	0	0	0	17	50	8	0	0	42	17	8	0	14	25	16	8					
41-50	0	0	8	8	34	0	0	8	25	0	0	0	0	75	17	0	0	17	17	8					
51-60	0	0	0	17	58	0	0	0	8	5	0	0	0	8	50	0	0	25	0	17					
61-70	0	0	0	0	0	0	0	0	0	58	0	0	0	0	25	0	0	0	25	9					
71-80	0	0	0	0	8	0	0	0	0	20	-	-	-	-	-	0	0	0	17	8					
81 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	50	0	0	0	0	65	0	0	0	0	100	0	0	0	0	100	0	0	0	0	100	28	0	0	0
11-20	50	100	50	8	8	35	68	8	0	10	0	75	8	0	0	0	90	33	8	0	0	72	50	0	0
21-30	0	0	42	59	17	0	27	50	27	0	0	25	92	25	0	0	10	42	17	8	0	0	50	8	8
31-40	0	0	8	33	33	0	5	17	27	20	0	0	0	58	0	0	0	25	50	25	0	0	0	83	33
41-50	0	0	0	0	34	0	0	25	0	10	0	0	0	9	0	0	0	0	17	42	0	0	0	9	59
51-60	0	0	0	0	8	0	0	0	18	10	0	0	0	8	0	0	0	0	8	8	-	-	-	-	-
61-70	-	-	-	-	-	0	0	0	28	20	-	-	-	-	-	0	0	0	0	9	-	-	-	-	-
71-80	-	-	-	-	-	0	0	0	0	20	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
81 and +	-	-	-	-	-	0	0	0	0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Prunus padus* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	10	0	0	0	65	0	0	0	0	52	0	0	0	0	14	0	0	0	0
51-100	0	32	0	0	0	35	45	17	0	0	43	33	0	0	0	82	19	8	0	0
101-150	0	47	0	0	0	0	40	67	17	0	5	57	42	0	0	4	28	34	8	0
151-200	0	11	83	0	0	0	15	8	33	8	0	5	33	8	8	0	48	25	42	0
201-250	0	0	17	8	0	0	0	8	42	25	0	5	25	42	0	0	5	25	9	25
251-300	0	0	0	75	8	0	0	0	8	42	0	0	0	17	8	0	0	8	8	25
301-350	0	0	0	17	33	0	0	0	0	25	0	0	0	8	9	0	0	0	25	16
351-400	0	0	0	0	50	-	-	-	-	-	0	0	0	25	42	0	0	0	8	17
401 and +	0	0	0	0	9	-	-	-	-	-	0	0	0	0	33	0	0	0	0	17

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	45	0	0	0	0	100	0	0	8	0	95	0	0	0	0	95	5	0	0	0
51-100	85	5	0	8	0	55	53	17	9	10	0	100	42	8	8	5	65	17	0	0	5	89	17	0	0
101-150	15	50	8	0	0	0	37	17	0	0	0	0	50	34	9	0	35	0	8	9	0	6	66	33	0
151-200	0	45	58	0	8	0	10	33	18	0	0	0	8	33	33	0	0	42	0	0	0	0	17	50	25
201-250	0	0	34	67	17	0	0	8	28	20	0	0	0	8	34	0	0	41	8	0	0	0	0	17	42
251-300	0	0	0	25	50	0	0	25	18	10	0	0	0	0	8	0	0	0	50	0	0	0	0	0	33
301-350	0	0	0	0	25	0	0	0	18	30	0	0	0	9	0	0	0	0	17	9	-	-	-	-	-
351-400	-	-	-	-	-	0	0	0	9	10	0	0	0	0	8	0	0	0	17	55	-	-	-	-	-
401 and +	-	-	-	-	-	0	0	0	0	20	-	-	-	-	-	0	0	0	0	27	-	-	-	-	-

Prunus tomentosa Thunb.

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the first series of descriptive reports (publication 02-9227).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Morden, Manitoba

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: The seeds, harvested in 1981, were received on September 21, 1983. They were sterilized for 30 seconds in a solution of equal parts ethanol and Javex® (6%). After three rinsings in distilled water, they were stratified for 307 days in moist peat at 20°C and for 41 days at 5°C. They were sown in a greenhouse on January 22, 1985, 30% having begun to germinate. The germination rate was 50% after five weeks. The plantlets were potted on February 21 in Melfert® plugs and kept in a greenhouse until June 3, at which time they were transplanted to the nursery; they were between 5 and 15 cm high. The seedlings were dug up on April 4, 1986, wrapped and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young seedlings 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

A number of seedlings died on transplanting and the loss was approximately 15% to 50% at seven of the eight sites.

As well, several seedlings died over the years at Sainte-Foy and Kapuskasing, while this mortality was concentrated in the last two winters at L'Assomption on clay, La Pocatière and Normandin.

Region 1

No damage occurred at the L'Assomption site on sand. This was the only site where no mortality was observed.

At the site on clay, a large percentage of the seedlings died; mortality was 27%, 25% and 17% during the second, fourth and fifth winters. The seedlings that died the last winter had been affected by rodents the previous winter.

At Sainte-Clotilde, two seedlings died, one during the second winter and the other the fifth winter; the latter had been severely affected by rodents the previous year.

Region 2

At Sainte-Foy, frost damage on the stem tips was the main damage observed on all the seedlings during the first and last winters. In addition, the flower buds were destroyed the second winter. The damage caused by rodents was very severe during the third winter, causing the death of 70% of the affected seedlings the following winter.

At Deschambault, rodents also damaged 38% of the seedlings the third winter. Mechanical breakage resulted in snapped branches during the last four winters on 20%, 25%, 16% and 38% of the seedlings.

At La Pocatière, frost damage on the stem tips affected 76% of the seedlings during the first winter and damage caused by rodents was observed on 30% of the seedlings the following winter.

Region 3

At Normandin, 90% or more of the seedlings suffered no frost damage the first three winters. The fourth winter, 58% of the seedlings died. The last winter, 40% of the seedlings suffered frost damage on the stem tips.

At Kapuskasing, gradual mortality resulted in the elimination of 10% to 30% of the living seedlings every year. Frost damage on the stem tips was observed on 60% to 75% of the seedlings three winters out of five.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.80 m R2 = 1.22 m R3 = 1.15 m

Categories

The average height of the shrubs after five years varied from one station to another:

- 2.01 m and + : Sainte-Clotilde
- 1.51 - 2.00 m: L'Assomption on sand, Deschambault and L'Assomption on clay
- 1.00 - 1.50 m: Kapuskasing, Sainte-Foy, Normandin and La Pocatière

The height of the seedlings was greater at Sainte-Foy and Normandin at the end of the second year of growth relative to that obtained after five years. Therefore, the results for the fifth year do not indicate the maximum height obtained at these sites.

Growth was poorer at all the sites on clay soil.

Effect of pruning

The severity of pruning was related to the extent of winter damage and damage caused by rodents.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.51 m R2 = 1.33 m R3 = 1.15 m

The maximum width was attained at several sites during the second and third years of growth.

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.51 - 2.00 m: Deschambault, Sainte-Clotilde and L'Assomption on sand
- 1.01 - 1.50 m: Kapuskasing, L'Assomption on clay and La Pocatière
- 1.00 m and - : Sainte-Foy and Normandin

Damage caused by field mice considerably reduced the growth of the seedlings.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and the width obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The growth of the seedlings from the Morden parent plant yielded slightly different results from the plants introduced in 1984. At the sites in regions 1 and 2, as well as at Normandin, 80% or more of the seedlings had attained a height of more than 1.00 m after two years of growth, while the growth of the plants evaluated from 1984 to 1989 was comparable at the Sainte-Clotilde and Sainte-Anne-de-Bellevue sites only.

However, after five years of growth, the plants introduced in 1984 and grown from cuttings were larger than the plants in this test, which were propagated by seeds.

Furthermore, mortality on transplanting was very high in this test, which was not the case in the 1984 test. At Normandin, the seedlings gradually withered starting from the second year of growth.

In conclusion, while it is possible to produce this species in regions 1 and 2, the provenance of the plants as well as the quality of their root system are particularly important factors to be considered for the production of this species.

Use

This is a very fast-growing species, since nearly 75% of the optimal growth was attained after two years of evaluation. In addition, it responds vigorously to pruning, i.e. the more extensive the pruning the greater the year's growth; however, it should be pointed out that severe pruning considerably reduces flowering.

Based on the results of the previous test, the clone evaluated from 1984 to 1989 was assigned a zone rating of 3, which corresponds closely to the hardiness potential of the plants tested. The seedlings from the Morden parent plant exhibited very poor survival in climatic zone 2. The zone rating of this clone can be maintained at 3, considering that in zones 4 and 5, mortality of the seedlings was closely associated with damage caused by

***Prunus tomentosa* Thunb.**

rodents and with the pedological conditions at the La Pocatière plot and in light of the fact that the other seedlings suffered very little frost damage.

This species requires winter protection against field mice, hares and other rodents. In addition, in zone 2, the plants can survive a few years without serious damage. However, if winter conditions are somewhat harsher, survival of a significant number of plants is jeopardized.

WRITTEN BY

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Table 1: Frequency of winter damage observed on *Prunus tomentosa* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	6	7	8	5 and 9	10	11	
REGION 1											
L'Assomption-clay	80	1					14			5	20
L'Assomption-sand	100										0
Sainte-Clotilde	77						3			20	23
REGION 2											
Deschambault	59	7					1		24	9	41
Sainte-Foy	5	40	15				14			26	95
La Pocatière	57	15		2			20			6	43
REGION 3											
Normandin	74	12		1			13				26
Kapuskasing	26	39				4	21	6	4		74

- ^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 splitting |
| 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 5, 6 and 9 occurred for this species.

Table 2: Breakdown of *Prunus tomentosa* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	16	0	0	0	0	0	7	0	0	0	7	0	0	0	0										
51-100	77	8	11	0	0	93	33	38	38	0	87	0	0	0	0										
101-150	7	92	56	33	22	7	60	62	62	40	6	93	0	0	0										
151-200	0	0	33	67	44	0	0	0	0	60	0	7	82	55	64										
201-250	0	0	0	0	34	-	-	-	-	-	0	0	18	45	36										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	20	0	15	0	0	0	0	100	70	25	0	0	0	0	0	0	20	50	11	0	0	0
51-100	67	17	0	20	50	85	20	13	0	0	0	30	75	100	50	59	13	0	0	0	50	67	29	20	0
101-150	33	83	70	60	50	0	80	37	62	50	0	0	0	0	50	41	75	83	92	80	0	22	71	80	100
151-200	0	0	30	0	0	0	0	50	25	50	-	-	-	-	-	0	12	17	8	0	-	-	-	-	-
201-250	-	-	-	-	-	0	0	0	13	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Prunus tomentosa* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	85	7	0	0	0	33	7	25	12	0	73	0	0	0	0
51-100	15	8	33	11	0	67	53	63	13	20	27	0	0	0	0
101-150	0	85	67	33	67	0	40	12	75	60	0	100	18	0	18
151-200	0	0	0	56	33	0	0	0	0	20	0	0	18	73	73
201-250	-	-	-	-	-	-	-	-	-	-	0	0	64	27	9
251 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	58	0	0	20	0	85	0	0	0	0	100	90	12	0	0	47	0	0	0	20	80	22	0	0	0
51-100	42	25	0	40	50	15	90	13	13	0	0	10	88	75	50	47	6	17	58	20	20	56	14	0	0
101-150	0	67	70	40	50	0	10	62	50	37	0	0	0	25	37	6	44	33	25	60	0	22	86	100	100
151-200	0	8	30	0	0	0	0	25	37	13	0	0	0	0	13	0	50	50	17	0	-	-	-	-	-
201-250	-	-	-	-	-	0	0	0	0	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251 and +	-	-	-	-	-	0	0	0	0	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Quercus palustris Muench.

See colour plate

Family	:	Fagaceae
English name	:	Pin oak, Swamp oak
French name	:	Chêne des marais
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree with a symmetrical growth habit can attain a height of 20 m, a width of 7 to 12 m, and a trunk diameter of 0.6 to 1 m. The trunk is straight and regular. It generally has numerous slender branches, oriented differently depending on their position on the trunk: they are ascending near the top of the tree, horizontal in the middle and curved downward near the bottom. The top is often conical or pyramidal in appearance.

The greyish-brown, fairly thin and rough bark cracks as the tree grows older to form narrow ridges that are so inconspicuous that the bark keeps its smooth appearance.

The branches are spindly, glabrous, greenish to reddish-brown the first year, becoming greener the following years. The overlapping buds are acute, smooth and light chestnut-brown.

The alternate, elliptic leaves are 7 to 15 cm long and almost as wide. They are composed of five, sometimes seven, horizontal lobes shaped like narrow, widely spaced rectangles, separated by deep rounded sinuses. They are dark glossy green on the upper surface but paler and glabrous beneath. However, there are tufts of hair at the point where the lateral veins arise. The foliage becomes red or bronze in the fall and some of the leaves remain on the tree all winter. The leaf stalk is slender and is 2 to 5 cm long.

Flowering is early: the flowers appear while the leaves are only in the first third of their development.

The tree begins to produce acorns at around 20 years of age. Production is optimal on 40 to 75 year-old trees.

The acorns are on average 1 cm long or less and are short-stalked. They are almost round; only the base is enclosed by a saucer-shaped cup, covered by thin, tight-fitting, finely pubescent scales with a brownish border. They ripen in the fall.

The root system is shallow and wide-spreading.

ORIGIN AND DISTRIBUTION

The geographical distribution of the pin oak, which originates in North America, covers only a small area of the Deciduous Forest Region in southern Ontario. In the United States, this species can be found in central Massachusetts, southeastern New York state, southern Michigan, North Carolina, Tennessee, southeastern Iowa, eastern Kansas and northeastern Oklahoma. This species is found mainly on poorly drained, moist clay soils, along swamps and streams. It is often found mixed with other deciduous trees, including other oaks, white elms, red elms and willows.

It is one of the North American oaks which adapts most successfully in Europe. It has been cultivated since the 1770s. It is found in large numbers in the cold regions of Australia.

USE

Ornamental: This species is widely used in groups or standing alone. In parks, when it is placed in an open space, it often keeps all its branches down to ground level. Its symmetrical shape and attractive foliage make it an excellent ornamental tree, despite the persistence of the foliage until late fall. The shade created is light and does not harm lawns.

Wood use: The wood is used in inlay work, flooring, cabinet-making and interior trim.

REQUIREMENTS

The pin oak prefers well-drained silty soils, but it can adapt to heavy, poorly drained soils. It is very tolerant of high pH levels, sulphur dioxide and urban conditions, but these stress conditions can cause chlorosis.

It is fast-growing: it can grow 4 to 5 m over a period of five to seven years.

It is relatively easy to transplant because of its shallow and spreading root system.

PATHOLOGY

Iron chlorosis can adversely affect its growth, but this problem is easily treated. This species is prone to the formation of galls.

PROPAGATION

Seedlings: The acorns can be sown immediately after harvesting. They should not be dried. Stratification for 30 to 45 days in a moist substrate promotes germination.

Propagation by cuttings: Tests conducted in the United States using this technique yielded a success rate of approximately 20%.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Germany

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

Propagation technique: The acorns were received on February 6, 1984. They were sterilized for one minute in a solution of equal parts water and Javex (6%), stratified for 60 days in moist sand at 5°C and sown on May 29. Seeding was done outside in a frame covered with a cloth providing 63% shade. The seeds began to emerge on July 11 and the germination rate was 82%. The seedlings were kept in the frame until October. They were dug up, puddled and heeled in. In the spring of 1985, they were wrapped and placed in a cellar until they were shipped in May.

Inclusion in test network: Young seedlings 15 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Mortality of the young seedlings occurred at the sites in regions 2 and 3 and at Sainte-Clotilde.

Winter damage

Region 1

The trees did not suffer any damage four years out of five, except at Sainte-Anne-de-Bellevue. The occasional damage observed occurred during the second, third or fourth winters, depending on the sites; frost damage on the tip of the previous year's shoot or mechanical breakage explain this damage.

At Sainte-Anne-de-Bellevue, almost all the seedlings affected by rodents during the first year or a subsequent year died during the following years, eliminating more than half the seedlings from the test.

Region 2

Frost damage on the tips of the shoots occurred at least four years out of five at the three sites in this region.

At Deschambault, mortality was low every year while at La Pocatière, it was very high the second and fifth years.

Damage on the entire previous year's shoot occurred the first two winters at La Pocatière, the fourth winter at Sainte-Foy and the last winter at Deschambault.

Region 3

At Normandin, damage on the stem tips occurred following the first three winters on 15% to 60% of the trees. However, 72% of the trees were affected more severely the last year. Only one seedling died following the second winter.

At Kapuskasing, severe damage on the entire year's shoot or on the stems down to the ground level affected certain seedlings from the first winter. The seedlings damaged in this way died during the following two years, leaving only a few living seedlings after three years of testing.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.01 m R2 = 1.15 m R3 = 1.30 m

Quercus palustris Muench.

The height of the trees in region 1 was clearly greater than that of the trees in the other regions, although the L'Assomption site on clay brought down the average.

The average for region 3 excludes the Kapuskasing site.

Categories

The average height of the trees after five years varied from one site to another:

- 2.01 - 2.30 m: Sainte-Anne-de-Bellevue, L'Assomption on sand and Sainte-Clotilde
- 1.51 - 2.00 m: -
- 1.01 - 1.50 m: Sainte-Foy, Normandin, L'Assomption on clay and Deschambault
- 0.51- 1.00 m: La Pocatière
- 0.50 m and -: Kapuskasing

Effect of pruning

Very little pruning was necessary at all the sites, with a few exceptions. To obtain straight trunks, a number of trees were severely cut back at Sainte-Foy at the start of the fourth year.

Growth in trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 29.3 mm R2 = 21.5 mm R3 = 18.3 mm

The difference between regions 1 and 2 was less pronounced for trunk diameter than for height. The average for region 3 excludes the Kapuskasing site.

Categories

The average diameter of the trees after five years varied from one site to another:

- 31 - 35 mm: Sainte-Clotilde and L'Assomption on sand
- 26 - 30 mm: Sainte-Anne-de-Bellevue and Deschambault
- 21 - 25 mm: Sainte-Foy and L'Assomption on clay
- 16 - 20 mm: Normandin and La Pocatière
- 6 - 10 mm: Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

After four years of testing, the average trunk diameter of the trees ranged from 30 to 40 mm for more than 50% of the trees at Sainte-Clotilde, while the height ranged from 1.50 to 3.00 m. After a fifth year, 75% of the trees at L'Assomption on sand, 50% of the trees at Sainte-Anne-de-Bellevue, 20% of the trees at Sainte-Foy and 30% of the trees at Deschambault had attained this diameter. None of the trees at the La Pocatière, Normandin and Kapuskasing sites attained this diameter.

The height of the seedlings was quite variable, particularly after the fourth year. At Normandin, 80% of the trees were more than 1.50 m high by the end of the testing period. Height alone is not representative of the production potential.

As was the case for *Quercus macrocarpa*, evaluated from 1984 to 1988, the production of *Quercus palustris* was faster in the region south of Montreal. It took a year longer at certain sites in the Quebec City region and the trees there were not as tall. It was not competitive in the other regions.

Use

This species suffered more severe damage in regions 2 and 3, particularly at La Pocatière, Normandin and Kapuskasing.

It does not seem to be adapted to zones as cold as that represented by Kapuskasing, where mortality of the trees was very high. The zone rating of 4 mentioned by Buckley seems to be consistent with the potential of this species. Based on the results obtained, the zone rating can be identified more precisely as 4b, since the La Pocatière site was more affected. In addition, growth on heavy and clay soils was very slow.

Despite the fact that this species is indigenous to North America, the acorns used in this test were of German origin. To follow up the results obtained, it would be interesting to conduct a new test and compare the



performance of these seedlings with that of seedlings with a different provenance.

BIBLIOGRAPHICAL REFERENCES

2, 3, 9, 12, 13, 21, 27, 28, 50, 51, 60, 71, 103

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Quercus palustris* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	3	4	6	7	8	5 and 9	10	11	13	
REGION 1												
L'Assomption-clay	93	7										7
L'Assomption-sand	98	2										2
Ste-Anne-de-Bellevue	12	48					16			14	10	88
Sainte-Clotilde	90								10			10
REGION 2												
Deschambault	58	11		6			9	6	10			42
Sainte-Foy	42	46		6			4	2				58
La Pocatière	4	37		16			26	16	1			96
REGION 3												
Normandin	62	22		14			2					38
Kapuskasing	44	18	2	8		4	24					56

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of type 6 occurred for this species.

Table 2: Breakdown of *Quercus palustris* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	100	100	17	0	0	100	100	50	8	0	100	81	17	0	0	100	100	57	25	25					
11-20	0	0	83	25	8	0	0	50	75	50	0	19	42	25	17	0	0	43	25	0					
21-30	0	0	0	75	17	0	0	0	17	42	0	0	41	25	25	0	0	0	50	25					
31-40	0	0	0	0	67	0	0	0	0	8	0	0	0	42	25	0	0	0	0	50					
41-50	0	0	0	0	8	-	-	-	-	-	0	0	0	8	17	-	-	-	-	-					
51-60	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-					
61 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	100	95	22	10	10	100	95	64	30	12	100	100	100	40	0	100	100	82	0	0	100	100	100	100	100
11-20	0	5	72	50	20	0	5	36	30	25	0	0	0	60	100	0	0	18	91	64	-	-	-	-	-
21-30	0	0	6	40	50	0	0	0	40	25	-	-	-	-	-	0	0	0	9	36	-	-	-	-	-
31-40	0	0	0	0	20	0	0	0	0	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41-50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51-60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Table 3: Breakdown of *Quercus palustris* by plants marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	95	8	0	0	100	100	58	0	0	100	71	17	0	0	100	100	71	0	0
51-100	0	5	75	8	0	0	0	42	75	42	0	29	17	25	17	0	0	15	0	25
101-150	0	0	17	33	8	0	0	0	25	33	0	0	58	17	8	0	0	14	25	0
151-200	0	0	0	50	25	0	0	0	0	25	0	0	0	33	8	0	0	0	50	25
201-250	0	0	0	9	42	-	-	-	-	-	0	0	8	17	25	0	0	0	25	25
251-300	0	0	0	0	25	-	-	-	-	-	0	0	0	9	33	0	0	0	0	25
301 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	89	22	10	10	100	100	55	30	12	100	100	100	20	0	100	80	73	0	0	100	100	100	100	100
51-100	0	11	56	20	0	0	0	45	30	25	0	0	0	80	100	0	20	27	91	18	-	-	-	-	-
101-150	0	0	22	50	30	0	0	0	40	50	-	-	-	-	-	0	0	0	9	55	-	-	-	-	-
151-200	0	0	0	20	60	0	0	0	0	13	-	-	-	-	-	0	0	0	0	27	-	-	-	-	-
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Quercus robur 'Fastigiata'

See colour plate

Family	:	Fagaceae
English name	:	Fastigate English oak
French name	:	Chêne pédonculé or chêne anglais
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree with a narrow, columnar growth habit can attain a height of 10 to 15 m and in rare instances more than 20 m. The width of the tree increases with age.

The trunk, with branches beginning close to the ground, is covered by furrowed blackish-brown bark.

The branches are numerous and grow parallel to the trunk.

The leaves, small compared to other species of oaks, are simple and the lobes are rounded and irregular. The glabrous leaves are glossy on the upper surface and dull beneath. The blade is widest in the upper third. The leaves are very pale green when young, then become olive green to dark green. In the fall, they turn coppery brown and remain on the tree for much of the winter.

This plant is monoecious.

ORIGIN AND DISTRIBUTION

This cultivar was discovered in Germany in 1783. This tree is planted throughout Europe, from the British Isles to North Africa and western Asia. The term "robur" is derived from the Latin word "*rubor*" which means red and refers to the reddish colour of the wood. The term "fastigiata" comes from Latin word "*fastigatus*" which means conical.

USE

Ornamental: This cultivar with a columnar growth habit can be used on small plots. It requires little maintenance

and is resistant to insects and diseases. It is also valued as a windbreak.

REQUIREMENTS

This tree grows in cool, moist, rich and even slightly compact soils; it is very suited to loams and clay soils. Like other oaks, it is fairly tolerant in terms of pH levels.

It forms a highly developed taproot which makes regeneration of growth after transplanting difficult. It is therefore preferable to plant it in the spring using the root ball method.

This tree prefers sunny exposures.

PATHOLOGY

To our knowledge, this oak does not appear to be affected by any serious disease.

PROPAGATION

Seedlings: The fastigate feature of this tree is stable and is observed on 80% of seedlings.

Grafting: This cultivar is grafted onto *Quercus robur*.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of the scions: City of Montreal Nursery, Terrebonne, Quebec

Origin of the rootstock: Arboretum of the Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The scions were taken in February 1985 from 15-year-old parent plants. The next day, they were veneer grafted onto two-year-old *Quercus robur* rootstock 25 cm high. The grafted plants were placed in a cold greenhouse. They were grouped on a bench in beds with warming cables, with the roots and the graft union covered with moist sphagnum moss. The stems and the substrate were drenched daily. In March, the plants were potted in Fertil Pots[®]. They were placed in shaded frames in May and then planted in the nursery on June 20. They were cultivated until the fall, dug up and heeled in for the winter. In May 1986, they were wrapped and shipped to the test sites.

Inclusion in test network: Young plants 30 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

The recovery rate after transplanting was greater than 95%. In general, the most severe damage was observed following the winter of 1988-1989, when intense cold spells occurred in the fall, before the first snowfalls.

Region 1

No frost damage occurred at the three sites. The only mortality, observed the second winter at the L'Assomption site on clay, involved one plant which had exhibited no growth the initial years.

Region 2

In zone 4b, 65% to 95% of the plants at Sainte-Foy suffered no damage four winters out of five, while at Deschambault, frost damage on the shoot tips was more common, affecting 33% to 67% of the plants annually. At the two sites, 60% and 67% of the plants exhibited frost damage on the stem tips following the winter of 1988-1989. In addition, 17% of the plants suffered frost damage on the tip of the previous year's shoot. The following winter, 8% of the plants at Sainte-Foy suffered frost damage on the old wood, while at Deschambault this damage was evident on 33% of the plants.

At La Pocatière (zone 4a), more than 40% of the plants suffered frost damage on the stem tips during the first and third winters, while 19% and 50% of the plants suffered frost damage on the previous year's shoot during the same years and 10% of the plants suffered frost damage on the old wood the first two winters. The mortality observed on four plants the fourth winter was associated with the unfavourable pedological conditions at this plot.

Region 3

Very little damage was observed at Normandin (zone 2b), with the exception of the fourth winter, when conditions were harsher; 25% of the plants there suffered frost damage on the stem tips and 17% suffered frost

damage on the previous year's shoot. Only one plant died during the first winter.

At Kapuskasing (zone 2a), frost damage was more frequent during the third winter, affecting 27% of the plants on the previous year's shoot and 55% of the plants on the stem tips. The fourth winter, 65% of the plants suffered frost damage down to the level of snow cover or to ground level. Four plants died during the first two winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 4.15 m R2 = 2.87 m R3 = 1.24 m

The plants at the Sainte-Foy site were clearly taller than those at the other two sites in region 2. The plants at Normandin were twice as tall as those at Kapuskasing.

Categories

The average height of the trees after five years varied from one station to another:

4.01 m and + : Sainte-Clotilde
 3.51 - 4.00 m : L'Assomption on sand
 3.01 - 3.50 m : L'Assomption on clay and Sainte-Foy
 2.51 - 3.00 m : Deschambault
 2.01 - 2.50 m : La Pocatière
 2.00 m and - : Normandin and Kapuskasing

Effect of pruning

Very little pruning was necessary for this species. However, at Normandin, some pruning was required in the spring of 1989 following very severe frost damage and the plants were cut back by more than 60%.

Growth in trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 59.5 mm R2 = 50.1 mm R3 = 32.4 mm

The plants in region 3 were clearly smaller. Annual growth was stable, particularly the last three or four years, depending on the site.

Quercus robur 'Fastigiata'

Categories

The average diameter of the trees after five years varied from one station to another:

61 - 70 mm:	Sainte-Clotilde
51 - 60 mm:	Sainte-Foy, L'Assomption on sand and L'Assomption on clay
41 - 50 mm:	Deschambault and La Pocatière
31 - 40 mm:	Normandin
25 - 30 mm:	Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined diameter or height.

Production

The establishment of this cultivar generally took a year and growth during the first growing season varied from 10 to 40 cm depending on the site, except at Kapuskasing where it was less. This cultivar exhibited regular annual growth in zones 4b and 5a. In zones 4a, 2b and 2a, it fluctuated depending on the year and was less than 25 cm at Kapuskasing.

This cultivar can be produced more quickly in regions with conditions similar to those at Sainte-Clotilde, since 95% of the plants had attained a height of 1.50 m or more after two years. A third year was necessary at the L'Assomption, Sainte-Foy and Deschambault sites to obtain trees of comparable height.

At the other sites, this cultivar is able to grow, but cannot be produced competitively.

Use

The frost damage frequently observed in zone 2a and the very slow growth of this cultivar (less than 1 m in five years) confirm that this tree is not adapted to this region. Furthermore, in zone 2b, relatively severe frost damage due to harsh winter conditions or late spring frosts indicate that this cultivar is not well adapted to this region.

The results at the La Pocatière site indicate that zone 4a is the hardiness limit for obtaining satisfactory growth of this cultivar. However, the risk of occasional frost damage can reduce the annual growth and delay the development of the trees in this zone.

BIBLIOGRAPHICAL REFERENCES

4, 6, 12, 13, 24, 25, 27, 49, 50, 53, 54, 60, 73, 101

WRITTEN BY

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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Quercus robur* 'Fastigiata' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	99					1				1	
L'Assomption-sand	100									0	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	35	52	4				8	1		65	
Sainte-Foy	63	32	3					2		37	
La Pocatière	55	24	12			5	4			45	
REGION 3											
Normandin	87	8	4			1				13	
Kapuskasing	30	34	5	11	16	4				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 splitting |
| 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 and 11 occurred for this species.

Table 2: Breakdown of *Quercus robur* 'Fastigiata' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	19	0	0	0	0	84	5	0	0	0	20	0	0	0	0
51-150	81	71	0	0	0	16	89	27	0	0	75	5	0	0	0
151-250	0	29	100	33	0	0	6	73	45	0	5	85	8	0	0
251-350	0	0	0	67	42	0	0	0	55	64	0	10	83	25	8
351-450	0	0	0	0	58	0	0	0	0	36	0	0	9	75	33
451 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	59

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	20	0	0	0	0	29	0	0	0	0	90	86	8	0	0	100	15	0	0	0	95	72	27	27	18
51-150	80	60	0	0	0	71	76	8	0	0	10	14	67	13	0	0	85	50	8	17	5	28	73	73	82
151-250	0	40	75	42	17	0	24	92	50	0	0	0	25	87	75	0	0	50	92	83	-	-	-	-	-
251-350	0	0	25	50	58	0	0	0	50	100	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-
351-450	0	0	0	8	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
451 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Quercus robur* 'Fastigiata' plants by marketable trunk diameter category from 1986 to 1990

Trunk diameter (mm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	67	0	0	0	100	85	18	0	0	100	10	0	0	0
21-40	0	33	100	50	0	0	15	82	55	0	0	90	67	0	0
41-60	0	0	0	50	84	0	0	0	45	82	0	0	33	75	17
61-80	0	0	0	0	8	0	0	0	0	18	0	0	0	25	83
81 and +	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-

Trunk diameter (mm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	10	0	0	0	100	86	0	0	0	100	100	75	0	0	100	100	33	0	0	100	95	0	64	27
21-40	0	90	92	25	8	0	14	100	67	0	0	0	25	100	38	0	0	67	100	67	0	5	0	36	63
41-60	0	0	8	75	59	0	0	0	33	92	0	0	0	0	62	0	0	0	0	33	0	0	0	0	10
61-80	0	0	0	0	33	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Quercus rubra L.

See colour plate

Family	:	Fagaceae
English name	:	Red oak
French name	:	Chêne rouge
Synonym	:	<i>Quercus rubra</i> var. <i>borealis</i>
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This indigenous tree can attain a height of 20 to 25 m and a diameter of 30 cm to 1 m; under ideal environmental conditions it can grow to a height of more than 30 m. The crown is wide and irregularly shaped, but the silhouette is more or less rounded.

The short and vigorous trunk divides into large principal branches. In the forest, the trunk is straight and branchless for more than half the height of the tree.

The roots are deep and extensive, sometimes with one becoming the taproot.

The bark is smooth and slate grey on young trees, then becoming grooved by shallow longitudinal furrows to form flat ridges.

The branches are sturdy, reddish-brown and glabrous. The buds, 5 to 6 cm long, are acute, glossy, reddish-brown and smooth, with a few brownish hairs at the tip.

The acuminate leaves are 12 to 25 cm long. They are glabrous and composed of seven to nine lobes separated by V-shaped sinuses. They are shiny green on the upper surface and can be whitish, greyish or pale green beneath. Soft green in the spring, they turn red or bronze in the fall.

The tree begins to produce acorns at around the age of 25. Its production, which peaks every two or three years, is optimal on 50 to 125 year-old trees.

The acorns, a third or more of which is enclosed in a saucer-shaped cup, are 2 to 2.5 cm long and almost as wide. The cup is covered with very tight-fitting, thin,

glabrous and reddish-brown scales. The shape of the acorns of this species is relatively variable.

The wood is pink to reddish-brown and the sapwood is almost white.

ORIGIN AND DISTRIBUTION

This species is commonly found throughout the Great Lakes-St. Lawrence Forest Region as well as in the Acadian Forest Region. This oak is often found in pure stands or mixed with other deciduous trees, particularly trembling aspens or white pines. At the northern limit of its range, it is found in pure stands at the top of rocky ridges. Its geographical distribution also extends as far as New England, northern Pennsylvania, Michigan and Iowa, the mountains of North Carolina, Nebraska to Georgia and southeastern Oklahoma.

It has been cultivated since the 1800s.

USE

Ornamental: This species is used standing alone or in groups when the space necessary for its full development is available.

Wood use: Red oak is not as strong as white oak, but is nonetheless used for cabinet-making, interior trim and flooring. It is also used to make barrels for holding dried foods only. The wood is strong, heavy and close-grained.

Culinary: The fruit is edible but bitter.

REQUIREMENTS

This tree prefers well-drained, acidic soils. It suffers from competition and prefers high, rocky or gravelly sites. Its deep root system enables it to withstand drought. It tolerates road salt and urban conditions well.

It is fast-growing: it can grow 60 cm annually over a period of more than ten years. It can be transplanted relatively easily because of its extensive root system.

It prefers sunny exposures.

PATHOLOGY

It is generally problem-free.

PROPAGATION

Seedlings: The acorns require stratification for 30 to 45 days at 2°C or 3°C in a moist substrate. The viability of the acorns is approximately nine months; desiccation reduces the germination rate.

Propagation by cuttings: On juvenile wood, hormone concentrations of 10,000 ppm can induce a certain percentage of rooting; the best results have been obtained in mid-June, in the United States.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: City of Sainte-Foy, Quebec

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

Propagation technique: The acorns were harvested in the fall of 1983. They were stratified for 93 days at 5°C and sown in a frame on May 25, 1984. On August 3, the germination rate was 37%. In October, the seedlings were dug up and heeled in until they were shipped in the spring of 1985.

Inclusion in test network: Seedlings 10 to 15 cm high and 3 to 5 mm in diameter were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

With the exception of those at Sainte-Anne-de-Bellevue and Kapuskasing, more than 80% of the seedlings did not suffer any damage during the testing period (Table 1).

Damage caused by rodents was evident only at two sites in region 1.

Region 1

Other than damage caused by rodents, there was no apparent damage on the seedlings, except at Sainte-Anne-de-Bellevue.

Mortality occurred the last two winters at Sainte-Anne-de-Bellevue on seedlings that had been gnawed two years out of three. At this site, damage on the stem tips occurred during the second, fourth and fifth winters. In addition, damage on the entire previous year's shoot occurred the fourth winter only.

Region 2

At La Pocatière, half the seedlings died following the second winter. However, this mortality occurred in the first two test replications, which were located in a low-lying area.

La Pocatière was the site where damage was greatest, and Deschambault where damage was least.

Region 3

At Normandin, more than 80% of the seedlings did not suffer any damage during the five years of testing, and damage to most of the previous year's shoot (9% of the seedlings) occurred the last winter only.

The types of damage observed were essentially the same at Kapuskasing as at La Pocatière, but the amount of damage was greater. However, mortality was more scattered.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.64 m R2 = 1.78 m R3 = 0.65 m

By the third year, the Sainte-Clotilde and L'Assomption on sand sites produced significantly taller trees.

Growth of the trees was clearly poorer on clay soils, even where winter damage was minor (L'Assomption on clay, La Pocatière and Normandin).

Categories

The average height of the trees after five years varied from one site to another:

3 m and + : Sainte-Clotilde and L'Assomption on sand
 2.01 - 2.50 m: Deschambault, Sainte-Foy and Sainte-Anne-de-Bellevue
 1.51 - 2.00 m: L'Assomption on clay

Quercus rubra L.

1.01 - 1.50 m: Normandin and La Pocatière
50 cm and - : Kapuskasing

Effect of pruning

Very little pruning was done on the seedlings, except for the choice of framework. However, severe pruning was carried out the last two years on trees whose main axis did not meet the shape criteria.

Growth in trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 30.7 mm R2 = 20.6 mm R3 = 11.0 mm

Growth in diameter was very similar to growth in height. However, statistical differences between the sites were apparent only during the final years.

Categories

The average diameter of the trees after five years varied from one site to another:

31 mm and + : Sainte-Clotilde and L'Assomption on sand
26 - 30 mm: Sainte-Anne-de-Bellevue
21 - 25 mm: Deschambault, L'Assomption on clay and Sainte-Foy
16 - 20 mm: La Pocatière and Normandin
10 mm and - : Kapuskasing

All the sites located on clay soils produced trees of smaller diameter.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and the trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

It took four years at Sainte-Clotilde to produce trees with a trunk diameter of 40 mm, and only 42% of the trees reached this size. At L'Assomption on sand it took five years for 67% of the trees to reach a diameter of between 36 and 46 mm, while only 58% of the trees at Sainte-Clotilde, and 10% to 16% of the trees at Sainte-Foy, Deschambault and Sainte-Anne-de-Bellevue fell into the same category.

The production of *Quercus rubra* is clearly faster at certain sites in the Montreal region. In view of the great variation observed in the diameter of the trees in the test, production and cultivation are not competitive in the other regions.

It was possible to obtain trees 2 to 2.50 m high only after three years of growth at Sainte-Clotilde and only on 50% of the specimens evaluated. It took an additional one or two years at the other sites, with the exception of the La Pocatière, Normandin and Kapuskasing sites, where the trees were unable to attain this height in five years. This species is difficult to train when the terminal bud of the main axis is affected by die-back.

Its growth is clearly favoured by sandy, well-drained soils.

Use

This species did not suffer serious winter damage even in zone 2b. However, because of its very slow growth in zones 2a and 2b, we are unable to determine precisely whether it can develop normally in zone 2. The zone rating of 3, assigned by Buckley, seems the most appropriate, at least until additional studies can provide more precise information on its growth beyond a five-year testing period.

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2, 3, 13, 21, 27, 28, 51, 60, 65, 71, 86, 92

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Quercus rubra* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	100									0	
L'Assomption-sand	100									0	
Ste-Anne-de-Bellevue	52	16	6			5			21	48	
Sainte-Clotilde	80								20	20	
REGION 2											
Deschambault	96		2					2		4	
Sainte-Foy	86	12	2							14	
La Pocatière	78	2	7	3		10				22	
REGION 3											
Normandin	91	4	2			1		2		9	
Kapuskasing	45	26	14			8	2	5		55	

- ^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 splitting |
| 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 and 7 occurred for this species.

Table 2: Breakdown of *Quercus rubra* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	100	71	0	0	0	100	90	50	8	0	100	38	0	0	0	100	85	33	33	10					
11-15	0	24	17	8	8	0	10	50	58	8	0	52	8	0	0	0	15	17	0	0					
16-20	0	5	58	0	0	0	0	0	17	33	0	5	9	8	8	0	0	42	17	10					
21-25	0	0	17	33	0	0	0	0	8	42	0	5	33	25	0	0	0	8	33	20					
26-30	0	0	8	42	17	0	0	0	9	8	0	0	42	25	17	0	0	0	9	40					
31-35	0	0	0	17	8	0	0	0	0	9	0	0	8	0	17	0	0	0	8	10					
36-40	0	0	0	0	34	-	-	-	-	-	0	0	0	25	16	0	0	0	0	10					
41-45	0	0	0	0	25	-	-	-	-	-	0	0	0	17	0	-	-	-	-	-					
46 and +	0	0	0	0	8	-	-	-	-	-	0	0	0	0	42	-	-	-	-	-					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	100	85	0	0	0	100	67	42	9	9	100	100	100	0	0	100	100	100	18	18	100	100	100	100	87
11-20	0	15	17	8	25	0	24	25	33	0	0	0	0	83	50	0	0	0	82	55	0	0	0	0	13
21-25	0	0	75	17	25	0	9	8	17	33	0	0	0	17	50	0	0	0	0	27	-	-	-	-	-
26-30	0	0	8	42	17	0	0	17	17	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31-35	0	0	0	33	25	0	0	8	8	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36-40	0	0	0	0	8	0	0	0	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41-45	-	-	-	-	-	0	0	8	8	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46 and +	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Quercus rubra* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	47	0	0	0	100	100	58	0	0	100	24	0	0	0	100	85	42	25	10
51-100	0	48	25	8	8	0	0	42	58	0	0	62	8	0	0	0	10	0	8	0
101-150	0	5	33	0	0	0	0	0	34	50	0	9	25	8	8	0	0	50	17	0
151-200	0	0	42	8	0	0	0	0	8	33	0	5	17	8	0	0	5	8	33	30
201-250	0	0	0	59	0	0	0	0	0	17	0	0	8	17	9	0	0	0	17	30
251-300	0	0	0	25	8	-	-	-	-	-	0	0	42	25	8	0	0	0	0	30
301-350	0	0	0	0	26	-	-	-	-	-	0	0	0	25	17	-	-	-	-	-
351-400	0	0	0	0	50	-	-	-	-	-	0	0	0	17	25	-	-	-	-	-
401 and +	0	0	0	0	8	-	-	-	-	-	0	0	0	0	33	-	-	-	-	-

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	57	8	8	0	100	71	42	25	8	100	95	100	17	16	100	100	91	27	0	100	100	100	100	100
51-100	0	43	42	17	8	0	29	25	17	17	0	5	0	33	17	0	0	9	73	64	-	-	-	-	-
101-150	0	0	33	25	17	0	0	8	17	0	0	0	0	50	50	0	0	0	0	26	-	-	-	-	-
151-200	0	0	17	33	8	0	0	8	8	17	0	0	0	0	17	0	0	0	0	10	-	-	-	-	-
201-250	0	0	0	17	33	0	0	17	8	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251-300	0	0	0	0	25	0	0	0	25	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301-350	0	0	0	0	9	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
351-400	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
401 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Rhododendron carolinianum var. *album*

See colour plate

Family	:	Ericaceae
English name	:	Rhododendron
French name	:	Rhododendron
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This compact and globular shrub can attain a height of 1.75 m.

The dark green alternate leaves are simple, elliptic, narrow and pointed. They are 5 to 8 cm long and 1.0 to 4.5 cm wide. They give off an aroma when crushed.

The flowers are white and abundant and flowering is spectacular for a period of three weeks.

ORIGIN AND DISTRIBUTION

The species is originally from Carolina and Tennessee. This variety has been cultivated since 1815.

USE

Ornamental: This slow-growing shrub is used standing alone or in clumps.

REQUIREMENTS

This species requires acidic, well-drained soil and prefers a site without too much shade. It tolerates sun well during its period of growth provided it does not suffer from drought.

PATHOLOGY

This species is often affected by insects, but good growing practices will reduce the incidence of insect problems.

PROPAGATION

Seedlings: The seeds must be sown in greenhouse conditions.

Propagation by cuttings: Softwood cuttings, taken in late July, have a rooting rate of approximately 50%.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Schumacher, United States

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

Propagation technique: The seeds were received on August 8, 1982 and sown in a greenhouse on January 28, 1983. On May 10, the seedlings were transferred to pots and placed outside under shade. On November 21, they were placed in a cold store at 60% relative humidity and 5°C under artificial light conditions for eight hours a day. On April 24, they were placed in a greenhouse and on June 13, they were transferred to an outside frame to be cultivated. In May 1985, they were wrapped for shipment to the test sites.

Inclusion in test network: Young seedlings 8 to 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

No plants survived at the sites in region 3.

Damage caused by rodents and damage from browning of the foliage were more common at the sites in region 2.

Region 1

At L'Assomption on sand, one seedling died following the third winter and two others the following winter. At the site on clay, mortality was almost total. Two seedlings survived the testing period. Mortality was particularly high the fourth winter.

At Sainte-Clotilde, two seedlings died during testing. In addition, all the seedlings suffered browning of the foliage the third winter and 30% the last winter.

At Sainte-Anne-de-Bellevue, no mortality occurred. However, frost damage on the flower buds occurred on almost all the seedlings following the third and fourth winters. All the seedlings suffered frost damage above the level of snow cover the last year. As well, 40% of the seedlings suffered damage by rodents the fourth year.

Region 2

At Sainte-Foy, one or two seedlings died every year. In addition, 20% of the seedlings suffered browning of the foliage the second winter and 20% to 70% were affected by rodents the last two winters. Frost damage on the stem tips occurred four years out of five.

At Deschambault and La Pocatière, only one seedling died at each site the second and third winters. Nearly 80% of the seedlings were affected by browning of the foliage the last two winters. At Deschambault, between 20% and 55% of the seedlings suffered mechanical breakage the last three winters and at La Pocatière, 50% of the seedlings were damaged by rodents the third winter.

Region 3

All the seedlings died the second winter at Normandin and almost all the seedlings died the first winter at Kapuskasing.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.44 m R2 = 0.49 m R3 = -

The two L'Assomption sites substantially lowered the regional average.

Categories

The average height of the shrubs after five years varied from one site to another:

0.51 - 0.60 m: Sainte-Clotilde, Sainte-Foy, Sainte-Anne-de-Bellevue and Deschambault
 0.41 - 0.50 m: La Pocatière
 0.31 - 0.40 m: L'Assomption on sand and L'Assomption on clay

No growth was observed the third and fifth years at the L'Assomption site on clay. The same lack of growth occurred the last two years at the L'Assomption on sand and Sainte-Clotilde sites.

Effect of pruning

Pruning was limited to elimination of the damaged portions of the stems.

Growth in width

After five years, the average width for each region was:

R1 = 0.64 m R2 = 0.71 m R3 = -

Categories

The average width of the shrubs after five years varied from one site to another:

0.71 - 0.80 m: Sainte-Clotilde, Sainte-Foy, L'Assomption on sand and Deschambault
 0.61 - 0.70 m: La Pocatière and Sainte-Anne-de-Bellevue
 0.51 - 0.60 m: -
 0.41 - 0.50 m: L'Assomption on clay

From the first year, the seedlings at Sainte-Clotilde were among the widest.

At all the sites, except La Pocatière, there was an annual increase in growth in width.

Flowering

The flowering period began between May 15 and 19 at the Sainte-Clotilde and Sainte-Anne-de-Bellevue sites, while it was observed between May 18 and 26 at L'Assomption. Flowering lasted from 10 to 20 days depending on the year and was more intensive the last 11 or 15 days. In the Quebec City region, the first flowers appeared between May 26 and June 2 for a duration of 13 to 20 days depending on the site. The peak flowering period lasted from 10 to 20 days. Mid-flowering occurred six to seven days after the appearance of the first flowers in region 1 and three to four days after the appearance of the first flowers in region 2.

Frost damage on the flower buds was observed following one winter in the Quebec City region.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and width obtained after each year. Nursery growers

***Rhododendron carolinianum* var.
album**

will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This variety cannot be produced in the northernmost zones since the seedlings died after one or two winters. It took two years of growth at Sainte-Clotilde and at Sainte-Anne-de-Bellevue for 70% to 75% of the seedlings to reach a height of 30 cm or more. At Sainte-Foy, 55% of the seedlings had attained this height.

At the La Pocatière, Deschambault and L'Assomption sites, a third or fourth year of growth were necessary.

The production of this species was significantly faster in the Montreal region, although growth was satisfactory at certain sites in the Quebec City region; damage from browning of the foliage was much more common in this region and affected the shrubs' appearance.

Use

This plant does not survive in climatic zone 2 nor does it adapt to heavy soils.

Mortality, which was observed on only one or two occasions at each of the sites, may be due to lack of vigour of the seedlings concerned.

The foliage of this species must be protected from winter desiccation, since this damage considerably diminishes the plant's appearance.

Based on the results obtained at Sainte-Anne-de-Bellevue and Sainte-Clotilde, this species can be assigned a zone rating of 5. However, lack of snow cover can result in significant losses in this zone. Nonetheless, well-established seedlings can survive in zone 4 in locations protected by snow and windbreaks (e.g.: Roger-Van den Hende Garden, Sainte-Foy).

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Table 1: Frequency of winter damage observed on *Rhododendron carolinianum* var. *album* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	3	4	6	7	8	5 and 9	10	11	14	
REGION 1												
L'Assomption-clay	58	3	10	2			26		1			42
L'Assomption-sand	78	17					5					22
Ste-Anne-de-Bellevue	34	6	30	2	20					8		66
Sainte-Clotilde	73						2				25	27
REGION 2												
Deschambault	23		6				1	7	20	3	40	77
Sainte-Foy	57	17		2			12	2		6	4	43
La Pocatière	43						2			11	44	57
REGION 3												
Normandin ^b	50							50				50
Kapuskasing	7							93				93

- ^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 7 and 9 occurred for this species.

- ^b All the seedlings died following the second winter at Normandin and almost all the seedlings died following the first winter at Kapuskasing.

Table 2: Breakdown of *Rhododendron carolinianum* var. *album* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	5	0	0	0	0					
11-20	80	10	0	10	0	57	24	17	17	0	76	0	0	0	0	95	5	0	0	0					
21-30	20	80	42	20	11	33	57	42	17	33	24	25	0	8	0	0	24	25	8	0					
31-40	0	10	50	70	67	0	19	41	66	67	0	55	0	17	0	0	57	33	25	10					
41-50	0	0	8	0	22	-	-	-	-	-	0	20	33	42	27	0	14	25	25	30					
51-60	-	-	-	-	-	-	-	-	-	-	0	0	50	8	45	0	0	17	42	40					
61-70	-	-	-	-	-	-	-	-	-	-	0	0	9	25	18	0	0	0	0	20					
71-80	-	-	-	-	-	-	-	-	-	-	0	0	8	0	10	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	0	0	0	0	0	5	0	0	0	0	19	0	0	0	0	33	17	0	0	0	24	33	0	0	0
11-20	43	6	9	0	0	81	5	0	0	0	71	33	0	0	0	57	67	0	0	0	52	67	0	0	0
21-30	52	39	0	0	11	16	62	10	0	0	10	67	18	9	0	10	16	0	0	0	24	0	0	0	0
31-40	5	50	36	0	0	0	33	45	18	9	0	0	64	64	55	-	-	-	-	-	-	-	-	-	-
41-50	0	5	36	70	22	0	0	45	64	46	0	0	18	27	36	-	-	-	-	-	-	-	-	-	-
51-60	0	0	9	30	44	0	0	0	18	45	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
61-70	0	0	10	0	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71-80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Rhododendron carolinianum* var. *album* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	50	5	0	0	0	29	24	0	33	0	24	0	0	0	0	100	5	0	0	0
21-40	50	65	8	0	11	71	76	58	50	33	76	55	0	0	0	0	71	17	17	0
41-60	0	30	50	90	11	0	0	34	17	67	0	45	42	33	10	0	24	66	25	50
61-80	0	0	42	10	44	0	0	8	0	0	0	0	58	25	45	0	0	17	58	50
81-100	0	0	0	0	23	-	-	-	-	-	0	0	0	42	45	-	-	-	-	-
101 and +	0	0	0	0	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	52	0	9	0	11	95	5	0	0	0	71	0	0	0	0	100	100	0	0	0	95	100	0	0	0
21-40	48	72	0	10	0	5	90	9	0	0	29	62	18	27	0	-	-	-	-	-	5	0	0	0	0
41-60	0	28	55	20	11	0	5	82	36	36	0	38	82	64	27	-	-	-	-	-	-	-	-	-	-
61-80	0	0	36	40	44	0	0	9	64	45	0	0	0	9	64	-	-	-	-	-	-	-	-	-	-
81-100	0	0	0	30	23	0	0	0	0	19	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-
101 and +	0	0	0	0	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Rhododendron carolinianum var. roseum

See colour plate

Family	:	Ericaceae
English name	:	Carolina rhododendron, deer-tongue laurel
French name	:	Rhododendron
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This compact and globular shrub can attain a height of 1.75 m.

The alternate leaves are simple with pointed, elliptic and narrow tips. They are 5 to 8 cm long and 1.0 to 4.5 cm wide. They are dark green on the upper surface, with a rusty appearance beneath. They tend to turn somewhat reddish during the winter. The leaves give off an odour of aromatic herbs when crushed.

The abundant lilac-pink flowers are 6 to 8 cm in diameter and bloom for approximately three weeks, starting in mid-May. The long stamens are highly decorative.

ORIGIN AND DISTRIBUTION

This species, indigenous to North America, is found in the United States, particularly on treeless mountain slopes and along rivers and streams.

USE

Ornamental: This slow-growing shrub is used in groups or standing alone.

REQUIREMENTS

This species requires acidic, well-drained soil and prefers a site without too much shade. It tolerates sun well during its period of growth provided it does not suffer from drought. It must be protected during the winter by snow fencing and good snow cover.

PATHOLOGY

The species is affected by several insects, but good growing practices will reduce the incidence of insect problems.

PROPAGATION

Seedlings: The seeds must be sown in greenhouse conditions.

Propagation by cuttings: Softwood cuttings, taken in late summer and treated with a solution of 2,500 ppm IBA, take root after a period of six to eight weeks.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Schumacher, United States

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

Propagation technique: The seeds were sown in a greenhouse on January 28, 1983. On May 10, the seedlings were transferred to small pots and placed outside under shade. On November 21, they were placed in a cold store at 60% relative humidity and 5°C under artificial light conditions for eight hours a day. On April 24, 1984, they were returned to a greenhouse and, on June 13, they were transferred to an outside frame to be cultivated. In May 1985, they were wrapped for shipment to the test sites.

Inclusion in test network: Young seedlings 9 to 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality, although less frequent in region 2, was very high at the sites in region 1 and affected all the seedlings in region 3.

Damage was very frequent, particularly following the last three winters.

Region 1

At L'Assomption on sand and on clay, mortality was very high following the third and fourth winters, resulting in the death of 25% and 67% of the seedlings respectively. In addition, at the site on clay, 25% of the seedlings died the last winter. Frost damage was observed following the third winter only: 60% of the seedlings suffered frost damage on the stem tips at the site on sand and all the seedlings were affected by frost damage on the flower buds or on the previous year's shoot at the site on clay.

At Sainte-Clotilde, only two seedlings died: one following the fourth winter and another the last winter. The seedlings suffered browning of the foliage, especially during the third winter.

At Sainte-Anne-de-Bellevue, all types of damage were observed and only the second winter was milder. Mortality was noted following the second winter and the last two winters; one to three seedlings died every time. The severity of damage increased over the years. The first winter, 67% of the seedlings exhibited frost damage on the stem tips. The third and fourth winters, 83% and 50% of the seedlings suffered frost damage on the flower buds. The last winter, 70% of the seedlings suffered frost damage above the level of snow cover.

Region 2

Every year at Sainte-Foy, 30% to 77% of the seedlings suffered no damage and 10% to 25% of the seedlings died. Frost damage on the old wood, damage caused by rodents and mortality occurred in every case on 10% to 20% of the seedlings and especially following the last three winters.

At Deschambault, the main damage was mechanical breakage caused by the weight of the snow on 50% to 80% of the seedlings following the last three winters. As well, 54% and 36% of the seedlings suffered browning of the foliage the last two years. The last winter, 18% of the seedlings died.

At La Pocatière, 75% to 90% of the seedlings were undamaged following the first three winters. The following winters, 67% and 100% of the living seedlings suffered browning of the foliage. Mortality occurred on 20% and 10% of the seedlings following the second and third winters.

Region 3

All the seedlings at Normandin died following the second winter and all the seedlings at Kapuskasing died following the first winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.41 m R2 = 0.45 m R3 = -

The La Pocatière site brought down the average for region 2, while the two L'Assomption sites brought down the average for region 1.

Growth in height stagnated beginning with the third or fourth year of testing, owing to the severe frost damaged suffered the last two winters.

Categories

The average height of the shrubs after five years varied from one site to another:

0.50 m and +: Sainte-Clotilde, Sainte-Anne-de-Bellevue, Sainte-Foy and Deschambault
0.30 - 0.40 m: La Pocatière, L'Assomption on sand and L'Assomption on clay

No plants survived more than two years at Normandin and Kapuskasing.

The height of the shrubs at the first four sites was clearly greater than at the other sites by the end of the fourth growing season.

Effect of pruning

Pruning was nil the first four years and minimal following the last winter.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.74 m R2 = 0.68 m R3 = -

***Rhododendron carolinianum* var.
roseum**

The L'Assomption site on clay was excluded from the regional average because the seedlings there attained less than half the width of the seedlings at the other sites. The La Pocatière site brought down the average for region 2.

Width increased slightly from the third to the fourth year.

Categories

The average width of the shrubs after five years varied from one site to another:

- 0.81 m and + : L'Assomption on sand
- 0.71 - 0.80 m: Deschambault, Sainte-Clotilde and Sainte-Foy
- 0.61 - 0.70 m: Sainte-Anne-de-Bellevue
- 0.51 - 0.60 m: La Pocatière
- 0.41 - 0.50 m: -
- 0.40 m and -: L'Assomption on clay

Annual growth was very significant the second year at L'Assomption on sand only.

Flowering

The flowering period began between May 15 and 19 at the Sainte-Clotilde site, and between May 24 and 29 at the other sites in region 1. Flowering lasted from 6 to 17 days depending on the year and was more intensive the last 10 days. In the Quebec City region, the first flowers appeared between May 24 and June 6 for a duration of 15 to 23 days depending on the site. The peak flowering period lasted from 12 to 19 days. Mid-flowering occurred two or three days after the appearance of the first flowers.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This variety suffered significant winter damage and mortality.

Growth was satisfactory at certain sites in regions 1 and 2 and the best growth in height was obtained after two years at Sainte-Clotilde and at Sainte-Foy. However, there was more damage at the Sainte-Foy site.

This is not a species that can be recommended for production in Quebec. Production is risky and can be very costly.

Use

This variety cannot be used in the northernmost zones since the seedlings died after one or two winters.

Damage was serious at all the sites and its severity increased as soon as the seedlings reached a height of 25 to 30 cm.

Adequate snow cover protects the seedlings and permits occasional flowering.

Based on the results obtained at Sainte-Anne-de-Bellevue and at Sainte-Clotilde, this species can be assigned a zone rating of 5. However, lack of snow cover can result in significant losses in this zone. Nonetheless, well-established seedlings can survive in zone 4 in locations protected by snow and windbreaks (e.g.: Roger-Van den Hende Garden, Sainte-Foy).

BIBLIOGRAPHICAL REFERENCES

3, 8, 60, 86, 98

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Rhododendron carolinianum* var. *roseum* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	3	4	6	7	8	5 and 9	10	11	14	
REGION 1												
L'Assomption-clay ^b	62		12	2			21	2	1			38
L'Assomption-sand ^b	70	12					18					30
Ste-Anne-de-Bellevue	25	13	27		14		10	3		8		75
Sainte-Clotilde	74			1			3				22	26
REGION 2												
Deschambault	20		6				5		44	3	22	80
Sainte-Foy	51	20					13	6		6	4	49
La Pocatière	58	1	1				6				34	42
REGION 3												
Normandin	0						100					100
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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

^b The percentage of undamaged seedlings is high but unrepresentative in this case since only three or four specimens remained after the fourth year.

Table 2: Breakdown of *Rhododendron carolinianum* var. *roseum* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	5	0	0	0	0	9	0	0	0	0	0	5	0	0	0	24	0	0	0	0					
11-20	67	10	0	14	0	52	33	0	0	0	67	0	0	0	0	62	5	8	0	0					
21-30	28	52	17	43	33	28	62	42	80	0	33	10	0	8	9	14	50	8	9	10					
31-40	0	38	58	43	33	11	5	58	20	100	0	71	8	0	9	0	35	25	9	10					
41-50	0	0	25	0	0	-	-	-	-	-	0	14	33	50	45	0	10	59	64	20					
51-60	0	0	0	0	34	-	-	-	-	-	0	0	42	42	9	0	0	0	18	60					
61-70	-	-	-	-	-	-	-	-	-	-	0	0	17	0	28	-	-	-	-	-					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	0	0	0	0	0	19	0	0	0	0	14	0	0	0	0	0	10	0	0	0	0	0	0	0	0
11-20	24	0	0	0	0	71	5	0	0	0	86	35	0	0	0	81	70	0	0	0	76	100	0	0	0
21-30	57	33	8	0	0	10	57	9	0	10	0	65	50	11	33	19	20	0	0	0	24	0	0	0	0
31-40	14	50	17	10	33	0	33	45	28	10	0	0	50	67	56	-	-	-	-	-	-	-	-	-	-
41-50	5	17	42	40	23	0	5	37	36	40	0	0	0	22	11	-	-	-	-	-	-	-	-	-	-
51-60	0	0	33	40	22	0	0	9	36	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61-70	0	0	0	10	22	0	0	0	0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Rhododendron carolinianum* var. *roseum* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	81	9	0	0	0	19	19	0	0	0	29	0	0	0	0	95	5	0	0	0
21-40	19	71	25	71	0	81	81	58	100	100	71	57	8	8	9	5	60	17	9	0
41-60	0	20	50	15	0	0	0	42	0	0	0	43	17	42	0	0	35	42	37	40
61-80	0	0	25	14	67	-	-	-	-	-	0	0	75	50	91	0	0	41	45	50
81-100	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	0	0	0	9	10
101-120	0	0	0	0	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	19	0	0	0	0	95	9	0	0	0	57	0	0	0	0	100	90	0	0	0	81	100	0	0	0
21-40	81	95	17	0	11	5	81	0	0	10	43	55	50	11	11	0	10	0	0	0	19	0	0	0	0
41-60	0	5	25	30	34	0	10	91	27	20	0	45	50	78	56	-	-	-	-	-	-	-	-	-	-
60-80	0	0	50	50	22	0	0	9	55	30	0	0	0	11	22	-	-	-	-	-	-	-	-	-	-
81-100	0	0	8	20	11	0	0	0	18	30	0	0	0	0	11	-	-	-	-	-	-	-	-	-	-
101-120	0	0	0	0	22	0	0	0	0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Rhododendron mucronulatum Turcz.

See colour plate

Family	:	Ericaceae
English name	:	Rhododendron
French name	:	Rhododendron
Synonym	:	<i>Azalea mucronulata</i> Hort.
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This erect shrub, with an oval or rounded growth habit, can attain a height of 1.20 to 1.80 m.

The stems are slender and brown-beige.

The leaves are alternate, simple and elliptic to lanceolate in shape. They are 2 to 10 cm long and 3 cm wide. They are green in the summer and become tinged with yellow to bronze and crimson in the fall. The finely textured leaves are very aromatic when crushed.

The flower buds are ovoid, glabrous and pale brown.

The pinkish-purple flowers bloom in the early spring. They develop at the tips of the branches before the new leaves and are approximately 4 cm in diameter. Flowering is somewhat irregular and lasts approximately three weeks.

ORIGIN AND DISTRIBUTION

This species originates in northern China, Manchuria, Korea and northern Japan. It was introduced in 1882.

USE

Ornamental: This species is used in groups or standing alone. Of all the rhododendrons, it is the first species to flower.

REQUIREMENTS

The species requires acidic, well-drained soil and prefers semi-shady sites. It is very sensitive to cold and must be protected during the winter by good snow cover and supported by a snow fence. It is slow-growing. Its very early flowering is sometimes interrupted by late spring frosts.

PATHOLOGY

The species is affected by several insects and is often very difficult to grow. Good growing practices will reduce the incidence of damage caused by disease.

PROPAGATION

Seedlings: The seeding technique is very simple.

Propagation by cuttings: Softwood cuttings, taken in late July, have a rooting rate of approximately 50%.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Oka, Quebec

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

Propagation technique: Cuttings of 10 cm were taken on July 7, 1983 and treated with a solution of 5,000 ppm IBA. They were placed in a mist propagator in a substrate composed of equal parts peat and perlite. The rooting rate was 95% on July 15. The plants were potted in small pots on August 6. They were placed in a cold store at 5°C and 60% relative humidity from October 21 to April 24, 1984 under artificial lighting conditions for eight hours a day. The plants were placed in a greenhouse from April 24 to June 13 and then placed outside until May 1985.

Inclusion in test network: Young plants 10 to 15 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality occurred at all the sites. No plants survived the five years of testing at the two L'Assomption sites,

at Normandin and at Kapuskasing. Several plants died at Sainte-Anne-de-Bellevue and at Sainte-Foy.

Region 1

At L'Assomption on clay and on sand, mortality was particularly high the second and third winters and no plants survived beyond the fourth winter at the first site. Only two plants survived at the sandy site. The percentage of undamaged plants refers mainly to the results for the first two winters.

At Sainte-Anne-de-Bellevue, mortality was gradual from year to year. The most severe damage occurred mainly the last three winters.

At Sainte-Clotilde, mortality was associated mainly with the third winter. The plants suffered frost damage on the entire previous year's shoot the last three winters.

Region 2

At Sainte-Foy and Deschambault, mortality was gradual and higher following the fourth winter. Successive damage caused by rodents was associated with the death of the affected plants.

La Pocatière was the site where the plants suffered the least damage, with slight frost damage or frost damage on the flower buds.

Region 3

At Normandin, mortality was high on planting and all the other plants died following the second winter.

At Kapuskasing, almost all the plants died following the first winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 56 cm R2 = 47 cm R3 = -

At some sites, few plants survived and the average is therefore less accurate. In addition, the average presented is the best obtained in the fourth or fifth year.

Categories

The average height of the shrubs after five years varied from one site to another.

The height was lower the last year at the La Pocatière and Sainte-Anne-de-Bellevue sites.

51 cm and +: L'Assomption on sand¹, Sainte-Foy and Sainte-Anne-de-Bellevue²
 41 - 50 cm: Sainte-Clotilde³, Deschambault⁴ and La Pocatière²
 20 - 30 cm: L'Assomption on clay⁴

¹ Based on one remaining plant.

² Average over four years only.

³ The average was 63 cm high after three years, but decreased as a result of damage.

⁴ The average was identical after the third year.

Growth in width

Width data were not sufficiently stable to warrant referring to them in this report.

Flowering

The first flowers appeared between May 14 and 21 at the Sainte-Clotilde and Sainte-Anne-de-Bellevue sites, and between May 18 and 27 at L'Assomption. The flowering period lasted from 10 to 20 days depending on the year, and the peak flowering period lasted from 6 to 13 days. Mid-flowering occurred four to seven days after the appearance of the first flowers.

In the Quebec City region, the first flowers were observed between May 26 and June 5 and the duration of flowering was 10 to 19 days depending on the site. The peak flowering period lasted from seven to 11 days.

Flowering occurred the last four years of testing at the sites in the Montreal region and three years out of four at the sites in the Quebec City region.

RECOMMENDATIONS

Production

For this species, it is not worthwhile drawing up a growth curve or production tables given the small number of plants that survived the testing period.

***Rhododendron mucronulatum* Turcz.**

However, it is possible to obtain a certain percentage of plants 50 cm high after two years at the sites in region 1 and at Sainte-Foy and Deschambault.

This species can be produced in Quebec under specific conditions and with good winter protection. However, the risk of losses is very high since this species is frost-sensitive.

Use

Sherk and Buckley (1972) referred to the hardiness evaluation system of the American Rhododendron Society. This species was classified as H-2, which means it is hardy down to -15°F (-26°C). In Quebec, this plant survived only at La Pocatière, Sainte-Foy and Deschambault, the heavy snowfalls there undoubtedly permitting the survival of this plant. Severe frost damage affects growth, damages the flower buds and causes high risks of mortality. This species should be zoned 6 or 7. However, this plant of rare beauty can be cultivated where the snow provides good protection from the beginning of cold winter weather.

BIBLIOGRAPHICAL REFERENCES

21, 27, 60, 86, 98

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Rhododendron mucronulatum* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	3	4	6	7	8	5 and 9	10	11	
REGION 1											
L'Assomption-clay	38						60		2		62
L'Assomption-sand	71	4					25				29
Ste-Anne-de-Bellevue	10	30	10	2	15		23	10			90
Sainte-Clotilde	40	18	2	32			8				60
REGION 2											
Deschambault	13	9	24	19		2	11	22			87
Sainte-Foy ^b	18	33		5		3	18	7		15	82
La Pocatière	62	2	25	2			5		4		38
REGION 3											
Normandin ^c	46						54				54
Kapuskasing	0			6			94				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 splitting |
| 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 | |

^b This average was based on four years of testing only.

^c This average was based on two years of testing only.

Ribes aureum Hort.

See colour plate

Family	:	Saxifragaceae
English name	:	Golden currant
French name	:	Gadelier doré
Synonym	:	<i>Ribes odoratum</i> Wendlandf
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This globular-shaped shrub, with an erect and upright growth habit, can attain a height of 1.75 m.

The new stems are yellowish-brown or reddish-brown and slightly pubescent. The older stems are purplish-grey and glabrous. They become wrinkled as they get older and the bark on certain sections of the stems peels off. Some specimens have resinous glands.

The foliage is dense and the leaves are orbicular, alternate, simple and three-lobed, 1 to 4 cm long. The new leaves are yellowish, becoming light green during the summer. The foliage turns red in the fall.

The yellow, trumpet-shaped flowers occur in racemes and are very fragrant. They are approximately 15 mm long and are borne on a long peduncle. They appear in large quantities on the old wood in the spring. The pistils and stamens are very conspicuous.

The fruit is 10 to 15 mm in diameter, maturing between late June and early August. It then becomes black or purplish.

ORIGIN AND DISTRIBUTION

This species is indigenous to the United States and was catalogued in 1812. It was introduced to Ontario and now exists there spontaneously. This species is found from Washington to Saskatchewan, and in Montana, New Mexico and California. It is often named *Ribes odoratum* and some authors still make distinctions.

USE

Ornamental: The spectacular and fragrant flowering is very attractive. This species is used standing alone or in clumps and to make free or pruned hedges.

Ornithology: This species particularly attracts hummingbirds.

REQUIREMENTS

This shrub tolerates sunny or semi-shady exposures. It also tolerates dry sites.

PATHOLOGY

No disease appears to particularly affect this species. However, like most currants, it is a host of white pine blister rust.

PROPAGATION

Seedlings: This type of propagation is used only occasionally and is possible on all pure species. The fruits are crushed when ripe and the seeds are cleaned. The seeds can be sown immediately or stratified and sown the following spring. After appropriate treatment, germination occurs rapidly and the seedlings can attain a height of 20 to 50 cm the first year.

Propagation by cuttings: Softwood cuttings, taken in June, take root rapidly. Hardwood cuttings are generally preferred for this species.

Grafting: This species is used as rootstock for several species or varieties of *Ribes*. Resumption of growth is easy and losses minimal.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Rosarium of the Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: 315 cuttings of 20 cm were taken on June 26, 1985. They were soaked in a solution of 4,000 ppm IBA and 50% ethanol and placed under mist for an average duration of 30 seconds every seven minutes in a substrate of perlite (100%). The rooting rate was 90% after four weeks. The plants were potted on July 30 in Fertil Pots® in a substrate composed of Pro-

Mix^o (50%), compost (25%) and sand (25%). They overwintered in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young plants 14 to 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

No damage occurred at the L'Assomption site on sand.

At Sainte-Clotilde and L'Assomption on clay, frost damage on the stem tips occurred respectively on 67% and 48% of the plants during the first winter.

Region 2

At Sainte-Foy, frost damage on the stem tips occurred on 100%, 55% and 42% of the plants during the first two winters and the fourth winter respectively.

At Deschambault, one plant died the first winter. Mechanical breakage occurred during the last two years on 8% and 17% of the plants.

At the La Pocatière site, frost damage on the stem tips occurred every winter, affecting 10% to 90% of the plants depending on the year; 30% of the plants also suffered frost damage on the previous year's shoot the first winter.

Region 3

At Normandin, most of the plants suffered frost damage on the stem tips every winter. In addition, 62% and 33% of the plants suffered frost damage on the previous year's shoot during the first and fourth winters respectively. Two plants died the first winter.

At Kapuskasing, 87% of the plants suffered frost damage down to the ground level the first winter and 13% died. The following winter, 68% of the plants suffered frost damage on the stem tips and 32% on the previous year's shoot. Subsequently, only mechanical damage was observed.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.18 m R2 = 1.02 m R3 = 0.89 m

Categories

The average height of the shrubs after five years varied from one station to another:

1.26 m and + : Sainte-Clotilde

1.01 - 1.25 m: L'Assomption on sand, Sainte-Foy and L'Assomption on clay

0.75 - 1.00 m: Deschambault, La Pocatière, Normandin and Kapuskasing

Effect of pruning

Pruning resulted in a reduction of the previous year's shoot of approximately 15% to 20% at most of the sites.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.16 m R2 = 1.22 m R3 = 1.06 m

The sites were very uniform within the same region.

Categories

The average width of the shrubs after five years varied from one station to another:

1.21 - 1.40 m: Sainte-Clotilde, L'Assomption on sand, Sainte-Foy and Deschambault

1.01 - 1.20 m: La Pocatière, Kapuskasing and Normandin

1.00 m and - : L'Assomption on clay

The plants grown on heavy soils were not as wide.

Flowering

At the sites in region 1, the first flowers appeared between April 27 and May 20 depending on the year. Flowering began between May 18 and 22 in region 2 and between May 20 and June 4 in region 3.

***Ribes aureum* Hort.**

The flowering period lasted from 25 to 35 days and full flowering occurred four or five days after opening of the first flowers.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height and width.

Production

This species is relatively fast-growing, since by the end of the second growing season, all the plants at L'Assomption on sand, Sainte-Clotilde, Sainte-Foy and Normandin had attained a height of between 50 and 100 cm. Subsequently, this height increased gradually at all the sites except Normandin, where it levelled off by the end of the second year.

Use

This golden currant was zoned 2 by Sherk and Buckley. In our testing, growth was excellent even in zone 2a. However, in zone 2, mild frost damage was frequently observed and more severe damage occurred on a few occasions. Since the ornamental features of this species remained attractive and since the severe frost damage occurred mainly in the first years, its zone rating for use can nonetheless be maintained at 2.

BIBLIOGRAPHICAL REFERENCES

4, 13, 20, 49, 50, 56, 57, 60, 71, 86, 95, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Ribes aureum* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage
		WINTER DAMAGE ^a								
		2	4	6	7	8	5 and 9	10	11	
REGION 1										
L'Assomption-clay	91	9								9
L'Assomption-sand	100									0
Sainte-Clotilde	87	13								13
REGION 2										
Deschambault	92	2				1		5		8
Sainte-Foy	61	39								39
La Pocatière	32	60	6				2			68
REGION 3										
Normandin	18	61	19			2				82
Kapuskasing	24	35	6		17	5		13		76

- ^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 splitting |
| 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, 5, 6 and 11 occurred for this species.

Table 2: Breakdown of *Ribes aureum* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	62	0	0	0	0	67	19	0	0	0	29	0	0	0	0										
51-100	38	100	75	0	0	33	81	100	83	33	71	100	50	0	0										
101-150	0	0	25	100	100	0	0	0	17	67	0	0	50	100	92										
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	15	0	8	0	0	72	10	0	0	0	100	10	0	8	8	10	0	0	0	0	76	5	0	0	0
51-100	85	95	42	58	33	28	90	100	83	50	0	90	92	83	34	90	84	67	100	100	24	90	100	83	100
101-150	0	5	50	42	67	0	0	0	17	50	0	0	8	9	58	0	16	33	0	0	0	5	0	17	0
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Ribes aureum* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	95	57	25	0	0	62	0	0	0	0
51-100	0	100	42	17	8	5	43	75	83	75	38	72	0	0	0
101-150	0	0	58	66	83	0	0	0	17	25	0	28	100	100	100
151-200	0	0	0	17	9	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	90	0	0	0	0	100	20	8	0	0	100	52	0	8	8	100	0	0	0	0	100	58	8	0	0
51-100	10	65	50	50	0	0	80	83	83	25	0	48	84	67	17	0	53	42	100	34	0	42	92	67	33
101-150	0	35	50	50	100	0	0	9	17	75	0	0	16	17	58	0	47	58	0	66	0	0	0	33	67
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	8	17	-	-	-	-	-	-	-	-	-	-

Ribes sanguineum Pursh.

See colour plate

Family	:	Saxifragaceae
English name	:	Winter or flowering currant
French name	:	Groseillier sanguin or groseillier à fleurs
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This indigenous shrub can attain a height of 2 m under favourable conditions, i.e. on the west coast. In Quebec, it rarely attains 1 m.

The young branches are reddish-brown, slightly downy and aromatic.

The foliage is dark green. The leaves are orbicular, 5 to 10 cm long and are composed of five shallow, wide and rounded lobes. The blade is irregularly toothed. It is glabrous or almost on the upper surface and paler and tomentose beneath. The base of the leaf is cordate or truncated.

Flowering takes place in the spring. The small, bright red or dark pink flowers develop in hanging clusters, 5 to 10 cm long, before leafing.

The globular fruits are small berries which become bluish or black in late summer.

ORIGIN AND DISTRIBUTION

This species, originally from British Columbia and the west coast, was discovered by Archibald Menzies in 1793. It was introduced to Great Britain in 1817 and to France in 1826.

USE

Ornamental: This species is used together with *Forsythia*, since their flowering period is essentially the same.

REQUIREMENTS

This species tolerates wet conditions but dry sites are not suited to it. It is distinctive in that it flowers equally well in sunny and shady exposures.

It must be pruned after flowering to give it a compact shape and to avoid loss of leaves at the base.

PATHOLOGY

This species can be severely affected by anthracnose (*Pseudopeziza* sp.). This fungus causes irregular brown plates on the leaves, which eventually fall off.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 270 cuttings of approximately 18 cm were taken on July 6, 1984 and soaked for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 100% after 39 days. Potting was carried out on August 3 and 14 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 15 and 25. The plants overwintered in the open frame under a thick cover of snow and the winter survival rate was 84%; 228 plants were transplanted to the nursery in May 1985 and the recovery rate was 92%. They overwintered in the nursery. They were dug up on May 2, 1986, pruned, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 10 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption on sand and L'Assomption on clay sites, damage was nil or slight the first two winters. Plant mortality was observed from the third winter on 33%, 25% and 17% of the plants at the L'Assomption site on sand and on 55% and 50% of the plants at the L'Assomption site on clay. In addition, frost damage down to the level of snow cover and/or ground level affected all the living plants.

At Sainte-Clotilde, plants died during the first three winters, affecting 5%, 30% and 25% of the plants in the test. As well, frost damage on the previous year's shoot occurred on 95% of the plants the first winter and frost damage down to the level of snow cover damaged 37% and 100% of the plants the third and fourth winters.

Region 2

At Sainte-Foy, all the plants suffered frost damage down to the level of snow cover or down to the ground level every year. In addition, 17% died during the fourth winter.

No mortality occurred at Deschambault. All the plants suffered frost damage down to the level of snow cover the second winter. Most of the plants exhibited signs of frost damage on the old wood during the third winter and frost damage on the previous year's shoot during the fourth winter. The last winter, 8% of the plants suffered no frost damage, while 17% suffered frost damage on the stem tips and 60% suffered frost damage on the previous year's shoot.

At La Pocatière, all the plants died on planting.

Region 3

At Normandin, 10% and 42% of the plants died during the first and fourth winters. No damage occurred on 60% or more of the plants the last four winters. Frost damage on the stem tips affected only 48% and 32% of the plants the first two winters.

At Kapuskasing, no plants survived the testing period. They died gradually over the years, the living plants having suffered frost damage down to the ground level or on the previous year's shoot.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.78 m R2 = 0.82 m R3 = 0.27 m

Growth was nil at the sites in region 3.

Categories

The average height of the shrubs after five years varied from one station to another:

0.76 - 1.00 m: L'Assomption on sand, Deschambault and Sainte-Foy

0.51 - 0.75 m: L'Assomption on clay and Sainte-Clotilde

0.50 m and - : Normandin and Kapuskasing

No gain in growth was observed at Normandin from the end of the first growing season. Furthermore, at several sites, the maximum height was attained by the second year.

Effect of pruning

Pruning resulted in a reduction of the previous year's shoot of approximately 50% to 90%, particularly after the second year of growth.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.48 m R2 = 0.65 m R3 = 0.25 m

The plants in region 3 exhibited very little growth during the testing period.

Categories

The average width of the shrubs after five years varied from one station to another:

0.51 - 0.75 m: Deschambault, Sainte-Foy and L'Assomption on sand

0.50 m and - : Sainte-Clotilde, L'Assomption on clay, Normandin and Kapuskasing

As was the case for height, there was little variation in this parameter between the end of the second year of growth and the end of the testing period.

Ribes sanguineum* Pursh.*RECOMMENDATIONS**

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

This species has no production potential in any region of Quebec. It is frost-sensitive and the extensive pruning made necessary by the very severe frost damage does not permit any significant growth.

Use

The plants suffered frost damage in all the zones evaluated. In the northern regions, this frost damage caused significant loss of growth, mortality and weakening of the vigour of the plants. In zone 5, frost damage was very severe and was similar to that observed on *Kerria japonica*, evaluated between 1984 and 1989. Unlike the latter, the ornamental features of this *Ribes* were expressed only at very protected sites. Although a certain number of plants managed to survive at the sites in regions 1 and 2 (except La Pocatière) and at Normandin, the zone rating of 7 assigned by Sherk and Buckley is quite probably appropriate to the potential of this species.

BIBLIOGRAPHICAL REFERENCES

4, 12, 40, 49, 50, 86, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Ribes sanguineum* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	18	20		24	15	21			2		82
L'Assomption-sand	20	20	8	29	8	15					80
Sainte-Clotilde	30		24	34		12					70
REGION 2											
Deschambault	2	4	44	25			21	4			98
Sainte-Foy	0			89	8	3					100
La Pocatière ^b	0					100					100
REGION 3											
Normandin	64	19	7			10					36
Kapuskasing	0	21	8		10	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 splitting |
| 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 types 3, 9 and 14 occurred for this species.

- ^b The plants at La Pocatière all died on planting.

Table 2: Breakdown of *Ribes sanguineum* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-25	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0										
26-50	38	5	0	0	0	81	0	8	57	0	37	0	25	17	17										
51-75	62	67	8	25	0	19	95	83	43	67	63	37	62	67	50										
76-100	0	28	77	75	100	0	5	9	0	33	0	63	13	16	33										
101 and +	0	0	7	0	0	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	5	17	0	28	58	39	17	100	100
26-50	0	0	0	17	10	48	10	0	8	0	-	-	-	-	-	0	32	25	33	29	42	33	83	0	0
51-75	100	0	0	25	30	52	57	50	34	33	-	-	-	-	-	76	42	42	25	43	0	28	0	0	0
76-100	0	24	58	58	60	0	33	50	58	50	-	-	-	-	-	24	21	16	42	0	-	-	-	-	-
101 and +	0	76	42	0	0	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Rosa X 'Martin Frobisher'

See colour plate

Family	:	Rosaceae
English name	:	Martin Frobisher rose
French name	:	Rosier 'Martin Frobisher'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This vigorously growing shrub can attain a height of 1.5 to 2.0 m and a width of up to 1.5 m in Ottawa. Its growth habit is straight and its growth is regular.

The bark of the largely thornless stems is dark red. The tips of the branches are unarmed.

The foliage is pale green and becomes yellowish in the fall.

Flowering is abundant and lasts all summer for an average period of 13 weeks.

The fragrant pinkish-white flowers are 5 to 6 cm in diameter. They have approximately 40 petals which remain attached to the peduncle after the flower has faded.

ORIGIN AND DISTRIBUTION

This rose is a hybrid produced from a free pollination of the 'Schneezwerg' rose with a rugosa rose. It was named in 1968 by Ms. Svejda, at the Agriculture and Agri-Food Canada Experimental Farm in Ottawa.

USE

Ornamental: This hybrid is used standing alone, in clumps for its flowers or as a free hedge at least 1.5 m high. To maintain its ornamental appearance, it is important to remove any dried and faded petals.

REQUIREMENTS

Dead wood must be eliminated in the spring.

PATHOLOGY

This hybrid exhibits good resistance to powdery mildew, but seems vulnerable to rose black spot disease and to certain cankers.

PROPAGATION

This hardy rose can be propagated by cuttings. Cuttings are taken in March or April from plants forced in a greenhouse or in May and June from parent plants placed outside. Treatment with a rooting hormone facilitates root formation, which requires approximately 20 days at a temperature of 20°C to 25°C under mist. The length of the cuttings and the date they are taken can influence how quickly they take root.

The rooting rate is very high and the survival rate the first winter is also high.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 373 cuttings of approximately 15 cm were taken on July 3, 1985 and immersed for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 91% after 37 days. Potting was carried out on July 31 and August 9 in Fertil Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 6 and 13 and growth continued during the fall. The plants overwintered in the open frame under a thick cover of snow and the winter survival rate was 97%. They were shipped between May 7 and 9, 1986.

Inclusion in test network: Young plants 20 to 30 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At L'Assomption on sand, the plants mainly suffered damage on the stem tips. During the fourth winter, frost damage on the above-ground portion exceeding the level of snow cover occurred on 67% of the plants; in addition, one plant died.

At the L'Assomption site on clay, similar damage was observed the fourth winter. As well, 54% of the plants suffered frost damage down to the level of snow cover and 10% of the plants died the last winter.

At the Sainte-Clotilde site, 67% of the plants suffered frost damage on the previous year's shoot during the second winter and down to the level of snow cover the last winter.

Region 2

Little damage was recorded during the first and last winters at Sainte-Foy. However, frost damage on the stem tips occurred on 62% and 100% of the plants the second and third winters respectively. The fourth winter, 92% of the plants suffered damage on the previous year's shoot.

At Deschambault, severe frost damage and plant mortality were observed the last three winters. Frost damage on the old wood affected 92% of the plants the third winter and half of these plants died the following winter. The fourth winter, 58% of the plants suffered frost damage down to the ground level and this frost damage resulted in the death of 20% of them the last winter.

At La Pocatière, frost damage on the above-ground portion exceeding the level of snow cover occurred during the first winter. The plants subsequently suffered only frost damage on the stem tips.

Region 3

At Normandin, frost damage on the previous year's shoot was evident on all the plants during the fourth winter and on 33% of them the last winter.

At Kapuskasing, damage was limited to frost damage on the stem tips, with the exception of the death of one plant the third winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.98 m R2 = 1.04 m R3 = 1.18 m

Categories

The average height of the shrubs after five years varied from one station to another:

1.26 m and + : La Pocatière
 1.01 - 1.25 m: Kapuskasing, Sainte-Clotilde and Normandin
 0.76 - 1.00 m: L'Assomption on sand, Sainte-Foy and L'Assomption on clay
 0.75 m and - : Deschambault

Effect of pruning

Pruning was fairly extensive, reducing the height of the plants by 30% to 50% every year. At most of the sites, with the exception of La Pocatière and Kapuskasing, the plants were cut back by 80% of their height following the fourth winter.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.76 m R2 = 1.06 m R3 = 1.20 m

The plants were as wide as they were high at the sites in regions 2 and 3, but higher than wide in region 1.

Categories

The average width of the shrubs after five years varied from one station to another:

1.26 m and + : La Pocatière and Normandin
 1.01 - 1.25 m: Kapuskasing
 0.76 - 1.00 m: Sainte-Foy, Sainte-Clotilde and Deschambault
 0.75 m and - : L'Assomption on sand and on clay

The more northerly the region, the greater the growth. The final height and width of the plants in region 1 were greater after the second year of growth. They subsequently decreased owing to extensive winter

Rosa X 'Martin Frobisher'

damage. At La Pocatière and at the sites in region 3, they increased during the five years of testing.

Flowering

This rose flowered very abundantly every year at all the sites. The first flowers appeared between June 11 and 23 at the sites in the Montreal region. The flowers were present until late September or mid-October, depending on the year. In the Quebec City region, flowering began eight to ten days later and ended, in general, in mid-September. In region 3, flowering invariably began around June 23 and ended, depending on the year, between September 15 and October 3.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This rose is very fast-growing. At the L'Assomption site on sand and at Sainte-Clotilde, 90% to 100% of the plants had attained a height of 1.00 m or more after two years. After a third year, the plants at all the other sites, except those at La Pocatière and Kapuskasing, had attained a comparable height. When cultivated in the nursery, this rose can be marketed at a height of between 50 and 100 cm, after two years. The compact appearance of the plants in region 3 reduces the amount of pruning necessary and thus favours the latter region and helps lower production costs.

Use

The potential height of this rose was attained only by a small percentage of plants at La Pocatière. Under Quebec climatic conditions, obtaining plants of this height is exceptional.

This hybrid rose is definitely better adapted to cold conditions; winter damage was less severe, light and occasional. Furthermore, the plants suffered less defoliation due to black spot. The plants were more

robust and their flowering there was equally abundant. At the sites in region 1, mortality was low, but repeated winter damage required severe pruning which reduced the final height of the plants. This rose is assigned a zone rating of 2, with the knowledge that it will have greater ornamental attraction in northern regions and less in southern regions because of its severe defoliation.

BIBLIOGRAPHICAL REFERENCES

4, 36, 52, 56, 82, 96

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Rosa X 'Martin Frobisher'* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	25	47	6	17		3		2			75
L'Assomption-sand	20	63		13		2		2			80
Sainte-Clotilde	40	34	13	13							60
REGION 2											
Deschambault	0	41	2		17	15	25				100
Sainte-Foy	46	34	18		2						54
La Pocatière	4	83	3	10							96
REGION 3											
Normandin	40	33	27								60
Kapuskasing	27	71			2						73

^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 splitting
10 = mechanical breakage related to weather conditions
11 = damage by rodents
14 = partial browning of the foliage

No damage of types 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Rosa X 'Martin Frobisher'* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde																			
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90															
0-50	71	0	0	0	0	34	0	0	0	0	19	0	0	0	0															
51-100	29	10	8	25	82	66	57	0	0	100	81	0	8	17	8															
101-150	0	90	92	67	18	0	43	100	100	0	0	100	92	83	92															
151-200	0	0	0	8	0	-	-	-	-	-	-	-	-	-	-															
Height (cm)	REGION 2										REGION 3																			
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	86	0	0	0	0	81	0	0	25	0	100	33	0	0	0	85	10	0	0	0	90	5	0	0	0	0	0	0	0	0
51-100	14	100	25	25	83	19	91	25	8	100	0	62	83	42	0	15	62	33	0	25	10	95	100	55	0	0	0	0	0	
101-150	0	0	75	75	17	0	9	75	67	0	0	5	17	58	83	0	28	67	100	75	0	0	0	45	100	0	0	0	0	
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 3: Breakdown of *Rosa X 'Martin Frobisher'* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	90	0	0	8	9	67	0	0	0	60	71	0	0	0	0
51-100	10	19	83	75	91	33	76	100	91	30	29	33	66	100	83
101-150	0	81	17	17	0	0	24	0	9	10	0	67	34	0	17
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	76	0	0	0	0	76	0	0	17	0	100	29	0	0	0	81	5	0	0	0	75	0	0	0	0
51-100	24	100	92	75	67	24	95	92	83	88	0	71	84	25	0	19	90	50	31	8	25	95	100	27	18
101-150	0	0	8	25	33	0	5	8	0	12	0	0	16	75	67	0	5	50	69	83	0	5	0	73	82
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	33	0	0	0	0	9	-	-	-	-	-

Rosa X Metis

See colour plate

Family	:	Rosaceae
English name	:	Metis rose
French name	:	Rosier 'Metis'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This upright shrub can attain a height of more than 1.5 m.

The light branches are reddish and the upper portion of the stems is almost thornless.

The alternate leaves are small, glossy dark green and composed of five to nine leaflets. They turn light red to dark red in the fall. The petioles are reddish.

The double flowers are very fragrant and amaranth pink in colour. Although the flowering period is short, the abundance of flowers makes it quite spectacular.

ORIGIN AND DISTRIBUTION

This hybrid is the result of controlled pollination between *Rosa nitida* and *Rosa* 'Thérèse Bugnet'. It was introduced in 1967 but is not very well known in eastern Canada.

USE

Ornamental: This species can be used standing alone for the beauty of its flowers, its foliage and its stems.

REQUIREMENTS

Like all roses, this species requires a sunny exposure. It grows very well in sandy soil.

PATHOLOGY

It is recognized as having good resistance to rose black spot disease and to powdery mildew.

PROPAGATION

Propagation by cuttings: Hardwood cuttings, taken between November and March, stored in wet sand at 4°C and placed in the ground again in the spring yield excellent results.

Softwood cuttings, taken in July or August and treated with a low concentration of IBA, take root easily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 392 cuttings of approximately 13 cm were taken on June 27, 1985 and immersed for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 95% after 43 days. Potting was carried out on July 26 and August 9 in Fertil Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 1 and 13 and growth continued during the fall. The plants overwintered in the open frame under a thick cover of snow and the winter survival rate was 90%. They were shipped between May 7 and 9, 1986.

Inclusion in test network: Young plants 13 to 17 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Mortality was very low for this species.

Region 1

At the L'Assomption site on sand, frost damage on the stem tips was observed following the first and third winters. At the L'Assomption site on clay, this type of damage was observed after every winter in proportions ranging from 20% to 100%. One plant died the third winter.

At Sainte-Clotilde, 33% of the plants suffered frost damage on the stem tips during the second and third winters.

Region 2

At Sainte-Foy, damage on the stem tips was observed on 60% of the plants following the third winter. Mechanical breakage was observed following one winter at Sainte-Foy, while at Deschambault 17% to 25% of the plants suffered this type of damage three winters out of five. In addition, at this site, there was only frost damage on the stem tips the second winter.

At La Pocatière, 47% of the plants exhibited signs of frost damage on the above-ground portion exceeding the level of snow cover during the first winter and 75% of the plants suffered frost damage on the previous year's shoot the third winter.

Region 3

At Normandin, frost damage on the previous year's shoot affected 65% and 100% of the plants the first and fourth winters. As well, one plant died at the end of the testing period and frost damage on the stem tips was observed on 35% and 92% of the plants the first and last winters.

At Kapuskasing, frost damage on the stem tips was observed the first two winters only.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.17 m R2 = 1.46 m R3 = 1.19 m

The maximum height was often attained during the second year of growth, particularly at the sites in region 1.

Categories

The average height of the shrubs after five years varied from one station to another:

1.50 m and + : Deschambault
1.26 - 1.50 m: La Pocatière, Sainte-Clotilde and Sainte-Foy

1.25 m and - : Normandin, Kapuskasing,
L'Assomption on sand and
L'Assomption on clay

Growth increased over the years at the Sainte-Foy, Deschambault and La Pocatière sites.

Effect of pruning

Pruning was extensive (50% or more) at several sites during the first and last years, for both the height and width of the plants.

Growth in width

After five years, the average width for each region was:

R1 = 1.72 m R2 = 1.73 m R3 = 1.59 m

At the sites in region 1, the average indicated is the average for the fourth year; the last season, the plants were cut back to facilitate movement. At all the sites in regions 2 and 3, the width of the plants increased every year.

Categories

The average width of the shrubs after five years varied from one station to another:

1.76 m and + : Deschambault
1.51 - 1.75 m: La Pocatière, Normandin, Sainte-Foy
and L'Assomption on sand
1.25 - 1.50 m: Kapuskasing, Sainte-Clotilde and
L'Assomption on clay

Flowering

The first flowers appeared between June 12 and 20 in region 1, and between June 18 and 28 in regions 2 and 3. Full flowering occurred four to six days later. The total duration of the flowering period was 20 to 30 days, but it can be significantly reduced by high winds.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Rosa X Metis**Production**

This rose is very fast-growing. After two growing seasons, more than 95% of the plants at L'Assomption on sand and Sainte-Clotilde had attained a height of between 1.01 and 1.50 m, while 75% of the plants at Deschambault were of comparable height.

At the other sites, a third year was necessary for 50% to 83% of the plants to reach a height of more than 1.00 m.

Use

This rose, which is not very well known and has not been assigned a zone rating in Quebec, demonstrated excellent adaptation to our climatic conditions. At all the sites in regions 1 and 2, frost damage on the stem tips was the only damage observed and did not affect the growth or appearance of the plants. In climatic zones 2a and 2b, this rose occasionally suffered frost damage on the previous year's shoot, but the final height attained was comparable in every respect to that at the sites in region 1. In addition, flowering was observed at all the test sites. For all these reasons, this rose can be assigned a zone rating of 2. Furthermore, the foliage was not affected by any disease during testing. The short duration of flowering is compensated by the beauty of the foliage, the colour of the stems and the graceful growth habit of this rose.

BIBLIOGRAPHICAL REFERENCES

4, 36

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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Rosa X Metis* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage	
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	43	56				1					57
L'Assomption-sand	61	39									39
Sainte-Clotilde	87	13									13
REGION 2											
Deschambault	70	12				1		17			30
Sainte-Foy	80	13						7			20
La Pocatière	3	73	15	9							97
REGION 3											
Normandin	40	25	33			2					60
Kapuskasing	67	33									33

- ^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 splitting |
| 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 types 3, 5, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Rosa X Metis* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	33	0	0	0	0	15	0	0	0	0	5	0	0	0	0										
51-100	67	5	0	0	8	85	90	82	9	45	95	0	25	0	0										
101-150	0	95	100	92	92	0	10	18	91	55	0	67	75	92	100										
151-200	0	0	0	8	0	-	-	-	-	-	0	33	0	8	0										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	33	0	0	0	0	14	0	0	0	0	95	5	0	0	0	65	0	0	0	0	29	0	0	0	0
51-100	67	67	17	0	0	86	25	0	0	0	5	95	33	25	0	35	60	50	8	0	71	76	17	0	0
101-150	0	33	83	100	100	0	75	100	92	25	0	0	67	75	83	0	40	50	92	100	0	24	83	100	100
151-200	-	-	-	-	-	0	0	0	8	75	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Rosa X Metis* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	52	0	0	0	0	10	0	0	0	0	43	0	0	0	0
51-100	48	0	0	0	67	90	35	8	27	55	57	0	33	17	0
101-150	0	95	75	33	33	0	65	92	73	45	0	100	67	83	92
151-200	0	5	25	67	0	-	-	-	-	-	0	0	0	0	8

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	43	0	0	0	0	15	0	0	0	0	86	5	0	0	0	45	0	0	0	0	38	0	0	0	0
51-100	57	34	0	0	0	85	65	8	0	0	14	95	0	0	0	55	0	0	17	0	62	42	0	0	0
101-150	0	53	83	83	25	0	35	58	100	0	0	0	83	67	8	0	80	50	75	0	0	53	100	58	67
151-200	0	13	17	17	75	0	0	34	0	100	0	0	17	33	92	0	20	50	8	100	0	5	0	42	33

Rosa multiflora Thunb.

See colour plate

Family	:	Rosaceae
English name	:	Japanese rose
French name	:	Rosier multiflore
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This large shrub, with a dense and erect growth habit and recurved stems, can attain a height of 3 m and a width of more than 2.5 m.

The stems are sarmentose and armed with small recurved thorns. The alternate leaves are generally composed of 9 oblong leaflets 2 to 3 cm long. They are acute or obtuse and often pubescent. They are light green and glossy during the summer, turning golden yellow in the fall.

Flowering is abundant. The small white, fragrant flowers are simple, approximately 2.5 cm in diameter and are borne in clusters. They appear in mid-July.

The globular fruits are oviform and light red. They remain on the stem tips until the winter.

ORIGIN AND DISTRIBUTION

This species originates in Japan or Korea and was discovered around 1800. It was introduced to the United States around 1868.

It is one of the parents of the polyantha race.

USE

Ornamental: This species is used in clumps or in hedges. It is also used as rootstock.

Naturalization: This species is excellent for stabilizing river banks and steep slopes as well as for making defensive hedges.

REQUIREMENTS

This species tolerates urban conditions, moist, heavy or acidic soils and drought well.

It is very fast-growing.

PATHOLOGY

This species seems resistant to rose black spot disease.

PROPAGATION

Seedlings: The seeds require stratification for 120 days.

Propagation by cuttings: Cuttings can easily be taken.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: The fruits were harvested in October 1984. The seeds were extracted manually and stratified in moist sand in a cold store at 4°C. They were sown in January 1985 in flats filled with a substrate composed of peat (50%) and vermiculite (50%) and placed in a hothouse at 20°C. Emergence of the seedlings was observed in February and March. Some 300 plantlets were potted in April in Fertil Pots[®] in a substrate composed of peat (60%) and perlite (40%) and the recovery rate was 100%; 250 seedlings were transplanted to the nursery on June 1. The winter survival rate was 100%. They were dug up on April 30, 1986, puddled, wrapped and placed in a cold store at 4°C until they were shipped a few days later.

Inclusion in test network: Young seedlings 60 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

R1 = 1.01 m R2 = 1.36 m R3 = 1.16 m

Winter damage

No plants died in this test. At most of the sites, the stems suffered frost damage above the level of snow cover.

Region 1

At the two L'Assomption sites, the seedlings suffered frost damage on the stem tips during the first winter or the first two winters. Subsequently, frost damage on the shoot above the level of snow cover was the main damage. In addition, a smaller number of seedlings were damaged by frost damage on the old wood or frost damage down to the ground level.

At Sainte-Clotilde, the seedlings suffered frost damage on the stem tips during the first three winters. Frost damage down to the level of snow cover was observed on all the seedlings the fourth winter. However, little damage occurred the last winter.

Region 2

At Sainte-Foy, all the seedlings suffered frost damage down to the level of snow cover every year, except the first winter, when 33% of the seedlings suffered damage on the stem tips.

At Deschambault, all the seedlings suffered frost damage down to the level of snow cover and on the old wood. A few seedlings were affected on the previous year's shoot or on the stem tips the last winter.

At La Pocatière, the behaviour of the seedlings was similar to that of the seedlings at Sainte-Foy and Deschambault.

Region 3

At Normandin, frost damage on the previous year's shoot affected all the seedlings the first three winters. Subsequently, they suffered frost damage down to the level of snow cover or down to ground level.

At Kapuskasing, frost damage affected the entire previous year's shoot the last three winters. The other types of frost damage occurred the fourth winter.

Growth in height

After five years, the average height of the shrubs for each region was:

Categories

The average height of the shrubs after five years varied from one station to another:

- 1.26 m and + : Deschambault, La Pocatière and Sainte-Foy
- 1.01 - 1.25 m: Normandin, Kapuskasing, Sainte-Clotilde and L'Assomption on sand
- 1.00 m and - : L'Assomption on clay

The maximum height was attained at almost all the sites by the end of the second growing season. Subsequently, severe pruning resulted in a reduction in the final height, despite annual growth of 50 to 100 cm. Only the La Pocatière and Kapuskasing sites exhibited a gain in height from year to year. The deeper snow cover at the sites in region 2 enabled the shrubs there to reach a greater final height.

Effect of pruning

The seedlings were cut back by 50% to 75% of their height mainly in the last three years of growth.

Growth in width

After five years, the average width for each region was:

R1 = 1.53 m R2 = 2.35 m R3 = 2.14 m

Categories

The average width of the shrubs after five years varied from one station to another:

- 2.51 m and + : Sainte-Foy
- 2.26 - 2.50 m: Normandin and La Pocatière
- 2.01 - 2.25 m: Deschambault and Kapuskasing
- 2.00 m and - : L'Assomption on clay, L'Assomption on sand and Sainte-Clotilde

The maximum width of the seedlings was attained by the end of the second year of growth for the sites in region 1 and by the end of the third year for the sites in region 3. Subsequently, there was a reduction in the width of the seedlings due to extensive pruning. Conversely, the width continually increased at the sites in region 2.

Rosa multiflora* Thunb.*BIBLIOGRAPHICAL REFERENCES**

4, 12, 13, 27, 36, 47, 49, 60, 86

Flowering

Flowering was observed two or three years at most of the sites, except at Normandin and Kapuskasing, where the seedlings did not produce flowers. The first flowers appeared around mid-June at the sites in region 1 and flowering lasted 13 to 15 days. In region 2, the first flowers bloomed five to ten days later and the duration of flowering was similar.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

By the end of the first growing season, the seedlings had attained a height of between 51 and 100 cm and a width often greater than 100 cm. The very rapid growth of this species allows it to be grown in a short period in all the regions. The snow cover determines the height at the beginning of the following season.

Use

This species can be assigned two zone ratings: a rating of 2 for survival and a rating of 5b for hardiness and growth, as defined by Sherk and Buckley. At all the sites, serious frost damage required extensive pruning, which substantially reduced the flowering potential of this rose. For making defensive hedges or for any other use where flowering is not important, this species can be recommended as far north as zone 2. Its vigorous annual growth and its response to severe pruning permit certain uses for naturalization, provided that pruning is possible. In addition, the lack of mortality and the vigorous growth of this species make it a hardy rootstock as far north as zone 2.

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Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Rosa multiflora* from 1986 to 1991

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	4	6	7	8	5 and 9	10	11	14		
REGION 1												
L'Assomption-clay	0	33		41	13				13		100	
L'Assomption-sand	7	20		66	7						93	
Sainte-Clotilde	20	60		20							80	
REGION 2												
Deschambault	0	2	6	51					41		100	
Sainte-Foy	0	7		93							100	
La Pocatière	0	20	2	75	3						100	
REGION 3												
Normandin	0		60	20	20						100	
Kapuskasing	0	24	66	10							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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 8, 9, 10, 11 and 14 occurred for this species.

Table 2: Breakdown of *Rosa multiflora* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	5	5	0	0	0	5	0	0	0	8	0	0	0	0	0										
51-100	90	5	8	17	42	95	38	8	41	50	100	0	0	0	25										
101-150	5	90	92	83	58	0	62	92	59	42	0	100	92	75	75										
151-200	-	-	-	-	-	-	-	-	-	-	0	0	8	25	0										
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	0	0	0	0	0	62	0	0	0	0	0	0	0	0	8	5	10	0	0	0
51-100	95	48	0	25	0	24	5	8	0	8	38	24	33	0	0	81	0	0	33	9	95	85	67	83	33
101-150	5	52	100	75	83	76	19	50	67	58	0	76	67	100	100	19	81	58	58	83	0	5	33	17	67
151-200	0	0	0	0	17	0	62	42	33	34	-	-	-	-	-	0	19	42	9	0	-	-	-	-	-
201-250	-	-	-	-	-	0	14	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Rosa multiflora* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51-100	71	0	0	0	0	33	0	0	0	17	57	0	17	0	0
101-150	29	0	0	8	42	47	10	8	0	8	43	0	83	42	83
151-200	0	48	75	92	58	20	33	92	100	42	0	100	0	58	17
201-250	0	52	25	0	0	0	38	0	0	33	-	-	-	-	-
251-300	-	-	-	-	-	0	19	0	0	0	-	-	-	-	-
301 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	9	0	0	0	0
51-100	0	0	0	0	0	24	10	0	0	0	57	52	0	0	0	62	0	0	0	0	33	0	0	0	0
101-150	48	0	8	0	0	67	90	0	17	0	38	48	0	0	0	38	5	0	0	0	48	0	0	0	33
151-200	52	38	42	42	8	9	0	58	17	33	0	0	33	33	33	0	43	33	100	33	10	43	0	17	17
201-250	0	33	42	58	50	0	0	42	66	58	0	0	58	50	67	0	52	0	0	33	0	43	42	33	33
251-300	0	10	0	0	42	0	0	0	0	9	0	0	9	17	0	0	0	58	0	34	0	14	17	42	17
301 and +	0	19	8	0	0	-	-	-	-	-	-	-	-	-	-	0	0	9	0	0	0	0	41	8	0

Rosa rugosa var. *typica* Thunb.

See colour plate

Family	:	Rosaceae
English name	:	Rugosa rose, saltspray rose, rough rose
French name	:	Rosier du Japon or rosier rugueux
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This upright shrub is 1.5 to 2.0 m high.

The green, coarse and erect branches are covered with a large number of thorns.

The alternate leaves are generally composed of 5 to 9 broadly oval leaflets. They are 3 to 5 cm long, obtuse and irregularly toothed. The blade is firm, dark green, rough, heavily wrinkled on the upper surface, glaucous and pubescent beneath.

The simple, very fragrant, pink-purple flowers are 6 to 8 cm in diameter and are solitary or in small clusters. The petals overlap, the receptacle is glabrous and the pedicels and sepals are villous. The flowers bloom briefly but the flower buds are constantly renewed for a period of several weeks.

The fruits, called hips, are globular or flattened, brick red or orange; they are 2 to 2.5 cm in diameter and are very decorative.

ORIGIN AND DISTRIBUTION

This species originates in northern China and Korea and was discovered around 1845 on dunes near the sea. It grows spontaneously along the shores of the St. Lawrence River and estuary.

USE

Ornamental: It can be used to make defensive hedges and it tolerates severe pruning quite well. It is also used in clumps where the thorns do not pose a hazard.

Naturalization: This species is very useful for steep slopes, sandy hills, sites with high salinity and along the seashore.

Culinary: The fruits are used to make a jelly.

REQUIREMENTS

This species tolerates seaside conditions and winds laden with salt spray quite well. It tolerates drought and adapts to all growing media.

It is very fast-growing.

PATHOLOGY

It is susceptible to powdery mildew, black spot disease, rust, aphids and several other insects.

PROPAGATION

Seedlings: The seeds require stratification or scarification for 120 days.

Propagation by cuttings: Cuttings can be taken easily. Hardwood cuttings, taken between November and March, stored in moist sand at 4°C and outplanted in the spring, yield excellent results.

According to some authors, softwood cuttings, taken in July or August and treated with a mild hormone concentration, take root better if the upper portion of the foliage is pruned.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were sown on April 10, 1982 in a frame. They were potted in Melfert® plugs in June 1984 and placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young seedlings 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the two L'Assomption sites, the seedlings were affected only by damage on the stem tips almost every winter.

At the Sainte-Clotilde site, frost damage on the stem tips was observed the second and third winters. The fourth winter, frost damage on the previous year's shoot, on the old wood and above the level of snow cover also occurred.

Region 2

No damage was observed at Sainte-Foy.

At Deschambault, 75% to 100% of the seedlings suffered no frost damage the last three years. However, frost damage on the above-ground portion exceeding the level of snow cover affected 33% of the seedlings during the second winter.

At La Pocatière, frost damage on the stem tips affected 5% to 75% of the seedlings, depending on the year. In addition, during the third winter, 60% of the seedlings suffered frost damage on the previous year's shoot.

Region 3

At Normandin, almost all the frost damage occurred during the first winter.

The seedlings at Kapuskasing suffered no frost damage the last four winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.02 m R2 = 1.07 m R3 = 0.87 m

Categories

The average height of the shrubs after five years varied from one station to another:

1.26 m and + : Deschambault
1.01 - 1.25 m: La Pocatière and Sainte-Clotilde
1.00 m and - : L'Assomption on clay, L'Assomption on sand, Kapuskasing, Normandin and Sainte-Foy

Effect of pruning

Pruning was extensive the last year, since the seedlings had become invasive.

Growth in width

After five years, the average width for each region was:

R1 = 1.10 m R2 = 1.46 m R3 = 1.23 m

At all the sites in regions 2 and 3, the width of the seedlings increased every year, while at the sites in region 1, it increased very little after the end of the second growing season.

Categories

The average width after five years varied from one station to another:

1.51 m and + : Deschambault and La Pocatière
1.26 - 1.50 m: Normandin
1.01 - 1.25 m: Sainte-Foy, Sainte-Clotilde, Kapuskasing, L'Assomption on sand and L'Assomption on clay

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This rose is very fast-growing. At all the sites, except Sainte-Foy, Kapuskasing and La Pocatière, 90% or more of the seedlings had attained a height of between 51 and 100 cm after two years of growth. This height varied

***Rosa rugosa* var. *typica* Thunb. ...**

little until the end of the testing period at the sites in region 1 and continued to increase at the sites in region 2. It is possible to produce this plant as far north as zone 2, given its vigour and rapid growth. However, since it is susceptible to several diseases, its use is limited.

Use

This species exhibited relatively little damage and performed quite well in terms of growth and flowering at the two sites in zone 2. The zone rating of 2b assigned by Sherk and Buckley can be modified to 2a.

BIBLIOGRAPHICAL REFERENCES

4, 12, 13, 27, 36, 47, 49, 50, 60, 65, 86

WRITTEN BY

Claude Richer, Agr.

Jacques-André Rioux, Agr.

Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Rosa rugosa* var. *typica* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	36	64									64
L'Assomption-sand	48	52									52
Sainte-Clotilde	51	37	8	2			2				49
REGION 2											
Deschambault	67	23		8				2			33
Sainte-Foy	100										0
La Pocatière	56	31	12			1					44
REGION 3											
Normandin	60	32	7			1					40
Kapuskasing	78	22									22

- ^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 splitting |
| 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 types 3, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Rosa rugosa* var. *typica* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	10	0	0	0	100	0	0	0	0	81	0	0	0	0
51-100	0	90	67	0	75	0	100	83	75	33	19	67	8	8	42
101-150	0	0	23	100	25	0	0	17	25	67	0	33	92	92	58
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Height (cm)	REGION 2														
	Sainte-Foy					Deschambault					La Pocatière				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	81	8	0	0	86	10	8	8	8	100	37	8	0	0
51-100	0	19	92	100	92	14	90	50	25	8	0	63	75	100	17
101-150	0	0	0	0	8	0	0	42	59	50	0	0	17	0	83
151-200	-	-	-	-	-	0	0	0	8	34	-	-	-	-	-
Height (cm)	REGION 3														
	Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	5	0	0	0	100	38	0	0	0	100	38	0	0	0
51-100	0	95	92	100	100	0	62	100	100	83	0	62	100	100	83
101-150	0	0	8	0	0	0	0	0	0	0	0	0	0	0	17
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Rosa rugosa* var. *typica* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	38	0	0	0	0	48	0	0	0	0	33	0	0	0	0
51-100	62	0	0	0	0	52	29	42	50	42	67	0	8	42	25
101-150	0	100	100	83	100	0	71	58	50	58	0	67	84	50	59
151-200	0	0	0	17	0	-	-	-	-	-	0	33	8	8	16

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	24	0	0	0	0	62	0	0	0	0	100	31	0	0	0	86	0	0	0	0	72	0	0	0	0
51-100	76	48	42	33	8	38	71	8	8	8	0	69	17	17	0	14	55	8	50	0	28	100	33	33	17
101-150	0	52	58	67	92	0	29	75	92	8	0	0	58	83	42	0	45	92	50	100	0	0	67	67	83
151-200	-	-	-	-	-	0	0	17	0	84	0	0	25	0	58	-	-	-	-	-	-	-	-	-	-

Shepherdia argentea Nutt.

See colour plate

Family	:	Elaeagnaceae
English name	:	Buffaloberry
French name	:	Sh��pherdie argent��e
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub with an irregular growth habit can attain a height of 5 m.

The bark is silvery and the stems are thorny.

The leaves are petiolate, entire and opposite. They are silvery on both sides.

The spring flowering consists of yellow flowers, which appear on the branches of the previous season. The pistillate flowers, with a perianth, are funnel-shaped and composed of four lobes; the staminate flowers have eight stamens.

The fruits are grouped into tight clusters along the stems of the female plants. Often scarlet, they also range from orange to yellow and are edible. They are ovoid, approximately 0.5 cm long, and each contain an achene.

ORIGIN AND DISTRIBUTION

This species is indigenous to Canada. It is found on the banks of streams in Manitoba, Alberta, Iowa, Kansas and northern New Mexico.

USE

Ornamental: The buffaloberry is used in the form of a free or pruned hedge, at least 1 m high. The foliage, flowers and fruits are most attractive when the shrub is used in clumps or in contrast with other plants. With proper pruning, it can be shaped into a very ornamental small tree.

Culinary: The fruits are used to make a jelly.

REQUIREMENTS

This species is very resistant to drought and adapts to light, dry and limestone soils.

It is more easily transplanted by the root ball method.

PATHOLOGY

To our knowledge, this species is not affected by any particular disease.

PROPAGATION

Seedlings: Natural dissemination of the seeds is by animals. The fruits can be harvested as soon as they ripen by shaking the shrub or by using gloves to avoid the thorns. Leaf and stem debris must be removed to avoid the overheating that would occur if fermentation were to begin. The fruits can also be soaked in water and the seeds extracted when the pulp floats.

Commercially, the seeds are available cleaned or in the form of dried fruits. The seeds can be stored at 2°C or 3°C and 13% humidity for at least 3 1/2 years.

The seeds must be stratified for 60 to 90 days at 5°C or undergo scarification with acid for 20 to 30 minutes, since the embryo is very well-protected.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: United States

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

Propagation technique: The seeds were sown in a greenhouse on June 1, 1983, after being soaked in water for two weeks. After emergence, the seedlings were transferred to individual cells, placed outside in the fall and planted out at L'Assomption on June 6, 1984. They were cultivated in the nursery until the spring of 1985. In May, they were wrapped and placed in a cold store until they were shipped a few days later.

Inclusion in test network: Young seedlings 14 to 18 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

There was very little mortality for this species. Damage caused by the snow occurred at four of the nine sites. In general, damage was very light, although somewhat more serious in region 3, with the appearance of frost damage on the entire previous year's shoot.

Region 1

No damage occurred at Sainte-Clotilde or at Sainte-Anne-de-Bellevue, other than frost damage on the tip of the shoots the fifth year at the latter site.

At L'Assomption on sand, only one seedling suffered damage caused by the snow.

At L'Assomption on clay, two seedlings were damaged by rodents, a third suffered frost damage on the old wood and another died following the fourth winter. In this case, the plant had begun to exhibit die-back during the year preceding its death.

Region 2

At La Pocatière, more than 90% of the seedlings were undamaged every year. Two seedlings died following the first winter and another following the third winter.

At Sainte-Foy, frost damage on the stem tips occurred on 24%, 58% and 33% of the seedlings following the second, third and fifth winters respectively.

At Deschambault, mechanical breakage affected between 25% and 50% of the seedlings during the last three winters.

Region 3

At Normandin, most of the seedlings did not suffer any damage, except following the third winter, when 67% of the seedlings exhibited frost damage on the entire previous year's shoot. Mechanical breakage occurred two winters out of five.

At Kapuskasing, a few cases of mortality occurred on seedlings that had exhibited signs of frost damage the previous year.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 2.53 m R2 = 1.83 m R3 = 1.17 m

The annual final height of the seedlings in region 1 was clearly greater than that of the seedlings in region 3.

Categories

The average height of the shrubs after five years varied from one site to another:

3.01 m and + : Sainte-Clotilde
 2.51 - 3.00 m: Sainte-Anne-de-Bellevue
 2.01 - 2.50 m: L'Assomption on sand and La Pocatière
 1.51 - 2.00 m: Deschambault and L'Assomption on clay
 1.01 - 1.50 m: Normandin, Sainte-Foy and Kapuskasing

The seedlings at Sainte-Foy exhibited no growth the last three years, as a number of them had suffered die-back during the growing season.

Effect of pruning

In general, very little pruning was done on this species, except the last year at Normandin.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.74 m R2 = 1.45 m R3 = 0.99 m

Categories

The average width of the shrubs after five years varied from one site to another:

2.01 - 2.50 m: Sainte-Anne-de-Bellevue, Sainte-Clotilde and La Pocatière
 1.51 - 2.00 m: L'Assomption on sand
 1.01 - 1.50 m: Deschambault, Sainte-Foy, L'Assomption on clay and Kapuskasing
 1.00 m and -: Normandin

Shepherdia argentea Nutt.

BIBLIOGRAPHICAL REFERENCES

2, 3, 27, 56, 60, 65, 71, 86

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The seedlings were very heterogeneous and showed significant individual variation.

After two years of growth, between 65% and 85% of the seedlings at L'Assomption on sand, Sainte-Clotilde, Sainte-Anne-de-Bellevue and Sainte-Foy had attained a height of 1.00 to 1.50 metres.

It took two years longer at Deschambault and at La Pocatière for more than 80% of the seedlings to attain this height.

At the other three sites, five years of growth were necessary for some of the seedlings to reach this height.

The production of this species is much faster in the Montreal region as well as at sites comparable to the Sainte-Foy site.

Use

The buffaloberry seems quite consistent with the hardiness potential mentioned in the literature, which assigns it a zone rating of 1.

No test site was located in zone 1, but Kapuskasing, situated at the limit of zones 1b and 2a, exhibited low mortality during the testing period.

This species can be used anywhere in Quebec, including in zone 1b. However, its growth is clearly poorer in colder regions. In addition, at a few sites, the seedlings evaluated suffered from die-back of portions of stems, the cause of which is unknown.

WRITTEN BY

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Table 1: Frequency of winter damage observed on *Shepherdia argentea* from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	94					2	1		3	6	
L'Assomption-sand	98							2		2	
Ste-Anne-de-Bellevue	80	20								20	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	68							32		32	
Sainte-Foy	77	23								23	
La Pocatière	95	2				3				5	
REGION 3											
Normandin	76		13						11	24	
Kapuskasing	74	8	3			5		10		26	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 6 and 7 occurred for this species.

Table 2: Breakdown of *Shepherdia argentea* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	10	0	0	0	0	32	15	0	0	0	19	0	0	0	0	15	0	0	0	0					
51-100	90	15	0	0	0	68	85	33	33	0	81	0	0	0	0	85	5	0	0	0					
101-150	0	85	58	25	0	0	0	50	25	36	0	38	0	0	0	0	95	25	17	0					
151-200	0	0	42	50	25	0	0	17	42	18	0	62	17	0	0	0	0	75	25	17					
201-250	0	0	0	25	33	0	0	0	0	46	0	0	58	25	8	0	0	0	58	33					
251-300	0	0	0	0	25	-	-	-	-	-	0	0	25	50	17	0	0	0	0	33					
301-400	0	0	0	0	17	-	-	-	-	-	0	0	0	25	75	0	0	0	0	17					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	48	0	0	0	0	100	5	0	0	0	62	33	0	0	0	100	81	27	0	0
51-100	100	43	42	25	25	52	67	0	0	0	0	95	0	0	0	38	67	42	0	17	0	19	73	40	50
101-150	0	57	33	50	58	0	33	75	8	8	0	0	100	0	0	0	0	58	83	58	0	0	0	60	50
151-200	0	0	25	8	0	0	0	25	75	50	0	0	0	45	18	0	0	0	17	25	-	-	-	-	-
201-250	0	0	0	17	17	0	0	0	17	42	0	0	0	55	64	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	0	0	0	0	18	-	-	-	-	-	-	-	-	-	-
301-400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Shepherdia argentea* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	0	0	0	0	0	48	15	0	8	0	72	0	0	0	0	67	0	0	0	0
51-100	100	19	0	0	0	52	85	58	58	27	28	14	0	0	0	33	33	0	0	0
101-150	0	81	83	67	25	0	0	42	34	55	0	81	67	17	33	0	67	17	17	8
151-200	0	0	17	33	50	0	0	0	0	18	0	5	33	67	42	0	0	83	50	33
201-250	0	0	0	0	25	-	-	-	-	-	0	0	0	16	25	0	0	0	33	42
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	10	0	0	0	0	71	0	0	0	0	100	0	0	0	0	100	19	0	0	0	100	67	18	0	0
51-100	90	33	17	17	8	29	57	75	8	8	0	95	25	0	0	0	81	83	42	83	0	33	73	30	40
101-150	0	67	75	83	67	0	43	25	84	59	0	5	75	0	36	0	0	17	58	17	0	0	9	70	60
151-200	0	0	8	0	25	0	0	0	8	33	0	0	0	64	64	-	-	-	-	-	-	-	-	-	-
201-250	-	-	-	-	-	-	-	-	-	-	0	0	0	36	0	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Spiraea japonica 'Goldmound'

See colour plate

Family	:	Rosaceae
English name	:	Goldmound Japanese spirea
French name	:	Spirée 'Goldmound'
Synonym	:	<i>Spiraea X bumalda</i> 'All Gold', <i>Spiraea X bumalda</i> 'Goldmound'
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This globular shrub, with a compact growth habit, can attain a height and a width of approximately 0.85 m and 1.50 m respectively, which is clearly greater than the official COPF descriptions (height = 0.45 m; width = 0.55 m).

The foliage is yellowish. The young leaves are yellow, tinged with red, turning golden yellow and finally lime yellow. They are alternate, simple and small.

The flowers, in flattened corymbs, are small and pale pink. They appear in July and are generally hermaphroditic.

Growth is moderate to rapid.

ORIGIN AND DISTRIBUTION

The word *Spiraea* means "coil" or "garland" in Greek; according to a legend, the Meadow Queen used these flowers to make garlands. In the 16th century, the name *Spiraea* was assigned to the entire genus by the botanist Charles de l'Escluse.

The *Bumalda* species is a hybrid obtained in 1985 by a Belgian horticulturist, Frédéric Burvenich, by crossing *Spiraea japonica* and *Spiraea albiflora*. *Bumalda* comes from Bumaldus, the Latin name of the Italian botanist and physician Ovido Montalbani, who lived from 1601 to 1671. The 'Goldmound' cultivar is the result of a crossing between *Spiraea japonica* and *S. X Bumalda*

carried out by the horticulturists of W.H. Perron and Co. Ltd.

In the case of an interspecific crossing of this type, the Americans give the cultivar the species name of the male plant *X Bumalda*, while the Europeans give it the species name of the female plant *japonica*.

USE

Ornamental: This cultivar can be used standing alone for the beauty of the foliage, in clumps, in rock gardens or in flower boxes.

REQUIREMENTS

Like all spirea, this cultivar must be planted in full sunlight. It prefers well-drained sandy soil with a pH between 6 and 7.

It is generally recommended that the branches be tied up in the fall, to avoid mechanical breakage caused by snow or ice.

Pruning can be done in the spring, before leafing.

PATHOLOGY

The spirea aphid (*Aphis spiraeicola*) appears around late June or early July. These green aphids infest the young shoots as well as the inflorescences. Nematodes also attack the spirea.

The main disease encountered in cultivation is powdery mildew, which causes light brown spots on the top of the leaves.

These two types of infestation are uncommon.

PROPAGATION

Seedlings: The seeds are harvested when they are brown. They can be sown without pretreatment. Seeds that have dried must undergo cold stratification for one to two months.

Propagation by cuttings: The cuttings take root easily and quickly. Softwood cuttings 10 cm long, treated with a solution of 4,000 ppm IBA and taken before flowering, have the highest rooting rate. The recommended substrate is a mixture of peat and perlite. The rooting period is two to four weeks.

Hardwood cuttings are taken in the fall after the leaves have fallen. They are placed in bundles, then soaked in a solution of 8,000 ppm IBA. They are stored in moist sand at 3°C during the winter. In the spring, before the buds break, they are planted out one by one. Half of the cutting is buried in the ground. The second year, the plants are cut back to obtain more robust specimens.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: L'Assomption, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 275 cuttings of 10 cm were taken on July 3, 1985 from a parent plant 40 cm high and 60 cm wide. They were soaked for five seconds in a solution of 5,000 ppm IBA and 50% ethanol. They were placed in a mist propagator in a substrate composed of peat (50%) and perlite (50%). The rooting rate was 85% after three weeks and 99% after five weeks. The plants were potted in Fertil Pots® on July 26 and August 9 and placed in a frame until April 4, 1986; the winter survival rate was 99%. They were dug up, wrapped and placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young plants 5 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the two L'Assomption sites, no damage occurred during the first two winters. At the site on sand, all the plants suffered frost damage on the stem tips the third and the last winter, and 67% to 100% of the plants at the site on clay suffered this type of damage the last three winters. During the fourth winter, 75% of the plants were damaged on the above-ground portion exceeding the level of snow cover at the site on sand and 33% at the site on clay.

No damage was observed at Sainte-Clotilde.

Region 2

The plants at the Sainte-Foy site suffered frost damage on the stem tips during the first two winters only.

No frost damage occurred at Deschambault; 17% of the plants suffered mechanical breakage two consecutive winters.

At La Pocatière, damage was particularly severe the first winter: 43% of the plants died, 25% suffered frost damage down to the level of snow cover or on the old wood and 33% on the previous year's shoot. The other four years, 60% to 100% of the plants did not suffer any damage. Some plants died every year.

Region 3

All the plants died during the first few winters at Normandin.

At Kapuskasing, the plants exhibited frost damage only on the stem tips the first, second and fourth winters, affecting respectively 100%, 39% and 83% of the plants. Two plants died the fourth winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.56 m R2 = 0.62 m R3 = 0.38 m*

* This average represents the average for the Kapuskasing site only.

Categories

The average height of the shrubs after five years varied from one station to another:

0.76 m and + : Deschambault
 0.61 - 0.75 m: Sainte-Clotilde
 0.46 - 0.60 m: L'Assomption on sand, Sainte-Foy and L'Assomption on clay
 0.45 m and - : La Pocatière and Kapuskasing

Spiraea japonica 'Goldmound'

Effect of pruning

Pruning was more extensive the last year at the two L'Assomption sites; pruning was related to winter damage.

Growth in width

After five years, the average width for each region was:

R1 = 0.90 m R2 = 1.09 m R3 = 0.60 m

Categories

The average width of the shrubs after five years varied from one station to another:

1.26 m and + : Deschambault
 1.01 - 1.25 m: Sainte-Clotilde
 0.76 - 1.00 m: Sainte-Foy, L'Assomption on sand and La Pocatière
 0.75 m and - : L'Assomption on clay and Kapuskasing

The plants were wider than they were high at all the sites and width followed the same growth pattern as height. The highest and widest plants were found at Deschambault, one of the two sites where no damage was observed.

Flowering

Depending on the year, the first flowers appeared between June 10 and 26 in the Montreal region and about 10 days later at the sites in region 2. At Kapuskasing, flowering generally began in the first half of July.

The period of full flowering lasted between 30 and 40 days and was followed by the blooming of a few inflorescences for an additional period of approximately 50 days.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual

production as well as the number of years necessary to obtain a predetermined height or width.

Production

In this test, the height of the plants was considerably greater than the potential indicated in the official descriptions of this cultivar.

The establishment of the plants during the first two growing seasons was faster in the Montreal region. In this region, 95% to 100% of the plants had attained a height of between 26 and 50 cm, while this percentage was 50% or less in the other regions.

Use

This cultivar yielded poorer results at sites with heavy and poorly drained soil. This is the main reason for the poor performance of this cultivar at the La Pocatière site, in zone 4a.

Damage was occasional at the sites located in zones 5 and 4b and, since damage was light, it had little effect on the subsequent growth of the plants. The results obtained at Kapuskasing indicate that use of this cultivar is possible when the plants are covered with snow during the winter.

At Normandin (zone 2b), no plants survived beyond the first winter. It would be worthwhile to test this cultivar again in order to gain a better understanding of the frost damage that occurred there. In light of these facts, it seems more prudent to assign this cultivar a zone rating of 4 until further tests are conducted.

BIBLIOGRAPHICAL REFERENCES

4, 50, 56, 61, 62, 63

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Spiraea japonica* 'Goldmound' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage								Cumulative damage	
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	39	53		7		1					61
L'Assomption-sand	40	45		15							60
Sainte-Clotilde	100										0
REGION 2											
Deschambault	92							8			8
Sainte-Foy	60	40									40
La Pocatière	0	67	15	3		13	2				100
REGION 3											
Normandin	0					100					0
Kapusksing	23	74				3					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 splitting |
| 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 types 3, 7, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Spiraea japonica* 'Goldmound' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-25	95	5	0	0	0	100	38	0	0	0	100	0	0	0	0										
26-50	5	95	25	0	25	0	62	92	75	75	0	100	9	0	18										
51-75	0	0	75	92	75	0	0	8	25	25	0	0	91	100	72										
76-100	0	0	0	8	0	-	-	-	-	-	0	0	0	0	10										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	90	0	0	0	100	58	0	0	0	100	100	14	0	0	100	0	0	0	0	94	100	50	25	10
26-50	0	10	83	8	33	0	42	50	0	0	0	0	86	100	100	-	-	-	-	-	6	0	50	75	90
51-75	0	0	17	92	67	0	0	50	75	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76-100	-	-	-	-	-	0	0	0	25	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Spiraea japonica* 'Goldmound' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	100	52	8	0	0	100	6	0	0	0
51-100	0	100	100	33	83	0	48	92	84	100	0	94	45	73	27
101-150	0	0	0	67	17	0	0	0	16	0	0	0	55	27	73
151 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	20	0	0	0	100	16	0	0	0	100	100	71	0	0	100	0	0	0	0	100	100	83	67	40
51-100	0	80	100	92	58	0	84	100	75	0	0	0	29	100	100	-	-	-	-	-	0	0	17	33	60
101-150	0	0	0	8	42	0	0	0	25	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151 and +	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Spiraea nipponica 'Snowmound'

See colour plate

Family	:	Rosaceae
English name	:	Snowmound Japanese spirea
French name	:	Spirée 'Snowmound'
Synonym	:	<i>Spiraea nipponica</i> var. <i>tosaensis</i>
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This compact, globular shrub can attain a height and a width of approximately 1.20 m and 0.80 m respectively. The erect and upright branches give rise to arched branchlets.

The foliage is glossy. The leaves are small, alternate, simple, dark green on the upper surface and bluish beneath.

The flowers, in flattened corymbs, are white and very abundant in May and June. They are small, simple and generally hermaphroditic.

ORIGIN AND DISTRIBUTION

The word *Spiraea* means "coil" or "garland" in Greek; according to a legend, the Meadow Queen used these flowers to make garlands. In the 16th century, the name *Spiraea* was assigned to the entire genus by the botanist Charles de l'Escluse.

The *nipponica* species originates in Japan and the Japanese spirea was introduced recently. It was discovered by the German naturalist Siebold in 1885 but was not introduced in Europe until 1908. It has been used to create several cultivars.

USE

Ornamental: This cultivar is mainly used standing alone or in clumps for the beauty of its flowering. It is slow-growing.

REQUIREMENTS

Like all spirea, this cultivar must be planted in full sunlight. It prefers well-drained sandy soil with a pH between 6 and 7.

It is generally recommended that the branches be tied up in the fall, to avoid mechanical breakage caused by snow or ice.

Since flowering takes place in the spring, this cultivar must be pruned after flowering.

PATHOLOGY

The spirea aphid (*Aphis spiraeicola*) appears around late June or early July. These green aphids infest the young shoots as well as the inflorescences. Nematodes also attack the spirea.

The main disease encountered in cultivation is powdery mildew, which causes light brown spots on the top of the leaves.

However, these two types of infestation are uncommon.

PROPAGATION

Seedlings: The seeds are harvested when they are brown. They can be sown without pretreatment. Seeds that have dried must undergo cold stratification for one to two months.

Propagation by cuttings: Softwood cuttings 10 cm long, treated with a solution of 4,000 ppm IBA and taken before flowering, have the highest rooting rate. The recommended substrate is a mixture of peat and perlite. The rooting period is two to four weeks.

Hardwood cuttings are taken in the fall after the leaves have fallen. They are placed in bundles, then soaked in a solution of 8,000 ppm IBA. They are stored in moist sand at 3°C during the winter. In the spring, before the buds break, they are planted out one by one. Half of the cutting is buried in the ground. The second year, the plants are cut back to obtain more robust specimens.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 413 cuttings of approximately 12 cm were taken on July 18, 1983 and immersed for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 99% after 36 days. Potting was carried out on August 23 in Fertal Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in sand in a cold frame on August 30. The plants overwintered in the open frame under a thick cover of snow and the winter survival rate was 95%; 248 plants were transplanted to the nursery in May 1984 and the recovery rate was 97%. In May 1985, they were cut back to 2 cm from the ground. They were dug up on April 25, 1986, puddled, wrapped and placed in cold storage at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 30 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, damage was limited to frost damage on the stem tips the first two winters. Damage was more severe during the third winter, affecting the old wood, and was worse the following two winters, damaging the above-ground portion which exceeded the level of snow cover.

At the site on clay, the severity of damage also increased over the years, with the percentage of plants affected being somewhat higher, since there was frost damage on the previous year's shoot in addition to frost damage on the stem tips.

No damage occurred at Sainte-Clotilde.

Region 2

At Sainte-Foy, frost damage on the stem tips was observed on all the plants the first two winters and on 33% of the plants the fourth winter. As well, some

plants were damaged by rodents the third and fourth winters.

At Deschambault, the plants were affected by frost damage and mechanical breakage: frost damage on the above-ground portion exceeding the level of snow cover was observed on 33% of the plants the second winter, while frost damage on the old wood affected 83% and 33% of the plants the third and fourth winters, and all the other plants were affected by frost damage on the previous year's shoot the last three winters.

At La Pocatière, all the plants in replication 1 died during the first winter and other plants died during the third and fourth winters; the unfavourable pedological conditions of the plot explain this mortality. Frost damage on the stem tips was the most frequent type of damage the first three winters. Subsequently, frost damage on the previous year's shoot and on the above-ground portion exceeding the level of snow cover affected all the plants.

Region 3

At Normandin, frost damage on the stem tips was observed during the first two winters and on the previous year's shoot during the other three winters.

At Kapuskasing, frost damage down to the level of snow cover and down to the ground level occurred the first winter, frost damage on the previous year's shoot was observed the third winter and frost damage on the old wood and on the stem tips occurred the last two winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.88 m R2 = 1.03 m R3 = 0.96 m

Categories

The average height of the shrubs after five years varied from one station to another:

1.01 m and + : Deschambault, Sainte-Clotilde and Normandin
 0.76 - 1.00 m: Sainte-Foy, Kapuskasing, L'Assomption on sand and La Pocatière
 0.75 m and - : L'Assomption on clay

Spiraea nipponica 'Snowmound'

There was no increase in the height of the plants from the second year at the Normandin, L'Assomption on clay and Sainte-Foy sites and from the third year at the L'Assomption site on sand.

Effect of pruning

Annual pruning resulted in a reduction in the height of the plants of approximately 60% to 80% from the third year at the four sites named above.

Growth in width

After five years, the average width for each region was:

R1 = 0.98 m R2 = 1.33 m R3 = 1.21 m

In all the regions, the plants were wider than they were high.

Categories

The average width of the shrubs after five years varied from one station to another:

1.51 m and + : Sainte-Foy and Deschambault
 1.26 - 1.50 m: Sainte-Clotilde and Normandin
 1.01 - 1.25 m: Kapuskasing and La Pocatière
 1.00 m and - : L'Assomption on sand and on clay

This cultivar does not grow as well on clay soils.

Flowering

Every year, flowering was observed on most of the plants at the sites in regions 1 and 2. Flowering began between June 3 and 15 in region 1 and eight to ten days later in region 2.

In region 3, flowering began between June 20 and 26 on the plants which flowered.

Full flowering occurred five to eight days after the appearance of the first flowers and the duration of flowering was approximately 15 to 25 days, depending on the year and the site.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After two years of growth, 67% and 52% of the plants at Sainte-Foy and Normandin had attained a height of 1.01 m or more. A third year of growth was necessary at Deschambault and Sainte-Clotilde to obtain comparable values. This species can be produced in all regions of Quebec, provided there is sufficient snow cover since, as soon as the shoots exceed the level of snow cover, damage can be relatively severe, even in zone 5.

Use

This cultivar is not currently assigned a hardiness rating. The test results revealed fairly severe frost damage at most of the sites located in zones 4 and 2. However, mortality was very low or non-existent in zone 4b, although frost damage often required severe pruning which eliminated a large number of flower buds, thereby reducing the ornamental potential of this spirea. Only the plants at the Sainte-Clotilde site exhibited no signs of frost damage. That is why a zone rating of 5b is assigned to this cultivar, with the knowledge that severe damage can occur in zones 5a and 4, where the plant can nonetheless partially express its ornamental potential when it is sufficiently protected by snow.

BIBLIOGRAPHICAL REFERENCES

4, 27, 61, 62, 63

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Spiraea nipponica* 'Snowmound' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	12	21	13	47			7				88
L'Assomption-sand	12	35		33			20				88
Sainte-Clotilde	100										0
REGION 2											
Deschambault	4		34	8			29	25			96
Sainte-Foy	33	47							20		67
La Pocatière	0	48	10	30		12					100
REGION 3											
Normandin	21	32	47								79
Kapuskasing	13	39	17	6	14	7	4				87

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 9 and 14 occurred for this species.

Table 2: Breakdown of *Spiraea nipponica* 'Snowmound' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	71	0	0	0	0	52	0	0	0	33	33	0	0	0	0										
51-100	29	100	100	92	66	48	100	100	100	67	67	67	25	8	0										
101-150	0	0	0	8	34	-	-	-	-	-	0	33	75	92	92										
151-200	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	5	0	0	0	0	100	80	11	13	0	5	0	0	8	0	62	0	0	0	0
51-100	100	33	0	8	0	90	71	16	25	0	0	20	89	87	57	95	48	0	8	0	38	85	50	80	29
101-150	0	67	100	92	50	5	29	84	75	58	0	0	0	0	43	0	52	100	84	100	0	15	50	20	71
151-200	0	0	0	0	50	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Spiraea nipponica* 'Snowmound' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-50	95	14	0	0	0	95	0	8	25	33	81	0	0	0	0
51-75	5	67	17	0	0	5	100	92	75	58	19	0	0	0	0
76-100	0	19	83	58	100	0	0	0	0	9	0	100	58	0	0
101-125	0	0	0	42	0	-	-	-	-	-	0	0	42	92	67
126 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	8	33

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-50	48	0	0	0	0	43	0	0	0	0	95	93	33	50	0	95	0	0	0	0	100	14	0	10	0
51-75	52	0	0	0	8	57	0	8	0	0	0	7	67	50	0	5	0	0	0	0	0	62	42	50	14
76-100	0	43	58	67	42	0	24	17	0	0	0	0	0	100	0	57	58	67	58	0	24	58	40	71	
101-125	0	57	42	33	50	0	71	67	100	75	-	-	-	-	0	43	42	33	42	0	0	0	0	15	
126 and +	-	-	-	-	-	0	5	8	0	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Syringa reticulata (Blume)

Hara

See colour plate

Family	:	Oleaceae
English name	:	Japanese lilac
French name	:	Lilas japonais
Synonym	:	<i>Syringa amurensis</i> Rupr. var. <i>japonica</i> (Maxim), <i>Syringa japonica</i> (Maxim) Decne
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This tree, with a rounded crown, can attain a height of 4 to 5 m. It can be grown as a multi-stemmed tree or with a single short trunk.

The bark of the young branches is beige tinged with reddish-brown. The branches have numerous lenticels and become grey and scaly as they get older. The lateral branches are relatively horizontal.

The dense foliage is dark green in the summer, turning brownish-yellow in the fall. The simple leaves are entire, opposite, oval, acuminate and are slightly pubescent on the lower surface.

The buds are sessile, globular and composed of four pairs of scales. The terminal bud is brownish and frequently aborts on the older stems.

The very fragrant flowers are grouped into wide, cream yellow panicles. Flowering is abundant by mid-June and occurs approximately two weeks after the other lilacs.

The fruits, dehiscent capsules, are approximately 1 cm long.

ORIGIN AND DISTRIBUTION

This species, discovered in the mountains of Japan by a Russian botanist in 1875, was named *Syringa amurensis* var. *japonica*. It had been described by other botanists, under various names, during the 1850s. It was

introduced to the United States in 1876 at the Boston Arboretum.

USE

Ornamental: This species is very often used standing alone in small gardens for its spectacular flowering or in groups in parks.

REQUIREMENTS

To induce the formation of a larger number of flower buds, the faded flowers must be cut. Like all lilacs, this species requires full sunlight and prefers slightly acidic soils.

PATHOLOGY

Lilacs are not attacked by a large number of insects and disease, but the enemies that do attack them are often implacable or difficult to control. Mildew caused by *Microsphaera penicillata* and various blights may be observed.

PROPAGATION

Seedlings: The fruits are gathered in late fall and dried in the open air. The seeds are stratified for 30 to 90 days and the germination rate generally ranges from 60% to 80%.

Propagation by cuttings: It is possible to take semi-hard heel cuttings, 6 to 10 cm long. A bottom temperature of 16°C and mist are suggested.

Grafting: Only cultivars are shield budded in August.

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 harvested on November 1, 1983. They were stored in a refrigerator at 5°C all winter. They were sown on April 1, 1984 in a frame. The seedlings were potted on September 1 and placed in a frame until they were shipped in the spring of 1986.

Inclusion in test network: Young seedlings 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Damage, observed occasionally, was more severe in climatic zone 2a at Kapuskasing.

Region 1

Three seedlings died at the two L'Assomption sites, at the rate of one plant the second, third and fourth years. No other winter damage occurred at these sites or at Sainte-Clotilde.

Region 2

At Sainte-Foy, 75% to 100% of the seedlings were undamaged. In 1989, 25% of the seedlings suffered frost damage on the stem tips and 8% exhibited the same type of damage the following winter.

At Deschambault, only mechanical breakage caused by the weight of the snow damaged 38% and 8% of the seedlings during the second and fourth winters respectively.

At La Pocatière, two seedlings died the last winter; no other damage was observed.

Region 3

At Normandin, 24% and 48% of the seedlings were affected by frost damage on the stem tips and/or on the previous year's shoot during the first two winters respectively. No other damage was observed subsequently.

At Kapuskasing, more than 85% of the seedlings did not suffer any damage four winters out of five. The fourth winter, 83% of the seedlings suffered frost damage down to the level of snow cover. In addition, a few seedlings were affected occasionally by frost damage down to ground level or by mechanical breakage. One seedling died the last winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 2.07 m R2 = 1.97 m R3 = 1.85 m

Categories

The average height of the trees after five years varied from one station to another:

2.51 - 3.00 m: Sainte-Clotilde, Normandin and Deschambault
 2.01 - 2.50 m: Sainte-Foy and L'Assomption on sand
 1.51 - 2.00 m: -
 1.00 - 1.50 m: L'Assomption on clay, La Pocatière and Kapuskasing

Annual growth was irregular from one site to another and from one year to another. However, growth was poor at all the sites during the year of establishment.

The Normandin site produced very tall trees compared to the other sites on clay soils or in colder zones.

Effect of pruning

These trees required little pruning for shaping.

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

More than 75% of the trees attained a height of 2 m or more after four years of growth at Sainte-Clotilde. A fifth year of growth was necessary at L'Assomption on sand, Deschambault and Normandin to obtain comparable results, while half of the seedlings at Sainte-Foy attained this height. These results demonstrate the possibility of producing this species in several climatic regions of Quebec, but with one year less in the zone south of Montreal.

***Syringa reticulata* (Blume) Hara**

The growth of this species is generally slower on clay soils unless these soils are very well structured like those at the Normandin site.

Use

The test results revealed the tolerance of this species for the climatic conditions in the various zones of Quebec. This species is quite hardy as far north as zone 2b. A few seedlings died during testing, but this mortality, observed at several sites, does not seem to be attributable to a lack of hardiness of the species.

The results at Kapuskasing demonstrated that this species can be severely damaged during a harsher winter.

When cultivated as a large shrub, winter damage is less likely to affect the appearance of the plants in zone 2a.

BIBLIOGRAPHICAL REFERENCES

4, 6, 13, 27, 32, 47, 78

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Syringa reticulata* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	96					4					4
L'Assomption-sand	99					1					1
Sainte-Clotilde	100										100
REGION 2											
Deschambault	89							11			11
Sainte-Foy	93	7									7
La Pocatière	96	1				3					4
REGION 3											
Normandin	85	9	6								15
Kapuskasing	77	2		16	1	2		2			23

- ^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 splitting |
| 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 types 3, 5, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Syringa reticulata* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-100	100	24	8	0	0	100	91	43	45	30	100	5	0	0	0										
101-200	0	76	92	67	25	0	9	57	55	70	0	95	83	25	0										
201-300	0	0	0	33	67	-	-	-	-	-	0	0	17	75	75										
301-400	0	0	0	0	8	-	-	-	-	-	0	0	0	0	25										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-100	100	34	17	0	0	100	19	8	0	0	100	100	100	58	0	100	14	0	0	0	100	100	92	17	25
101-200	0	66	75	83	50	0	81	83	58	8	0	0	0	42	100	0	86	100	41	16	0	0	8	83	75
201-300	0	0	8	17	50	0	0	9	42	75	-	-	-	-	-	0	0	0	59	59	-	-	-	-	-
301-400	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-

Tamarix ramosissima Ledeb.

See colour plate

Family	:	Tamaricaceae
French name	:	Tamarix
English name	:	Five-stamen or Amur tamarix, salt cedar
Synonym	:	<i>Tamarix pentandra</i>
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub can attain a height of 2.5 to 3.0 m. The growth habit is erect, but also loose and open.

The branches are reddish-brown, fine and drooping. The very fine texture of the foliage gives the branches a feathery appearance. The alternate, simple, lanceolate to ovate, acuminate and glaucous leaves are scale-shaped. They are 0.25 cm long and are bluish-green. They appear in late spring.

The buds are small, sessile, rounded, compressed the length of the stem, solitary and covered with three scales.

The pinkish flowers, in racemes, appear during the summer and last until the fall. They form on the year's shoot. The clusters are 2 to 7 cm long and the inflorescences cover the stem over a length of more than 1 m.

ORIGIN AND DISTRIBUTION

The natural distribution of this species ranges from southeastern Europe to central Asia. It was discovered around 1885.

USE

Ornamental: This species is quite often used standing alone for its spectacular flowering, very fine foliage and open growth habit. It is also used on sandy escarpments and as a free hedge.

REQUIREMENTS

This species prefers acidic soils and adapts to salty or wet sites and to drought. It stands up well to winds and grows better in full sunlight.

Pruning must be done very early in the spring, since the flowers form on the new shoots. Frequent pruning is necessary to preserve an interesting growth habit.

Transplanting using the bare root method is relatively difficult. It is better to cultivate this species in containers.

This species is very fast-growing under good growing conditions.

PATHOLOGY

Some forms of cankers and mildews are encountered on this species, but infrequently.

PROPAGATION

Seedlings: Freshly harvested seeds germinate within 24 hours after seeding if they were soaked for 24 hours in water. No treatment is required.

Propagation by cuttings: Softwood cuttings, placed in a substrate of perlite and peat, take root easily. The roots are weak and transplanting must be done carefully. It is also possible to propagate this species using hardwood cuttings planted in the spring before the roots form.

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: 400 hardwood cuttings of 20 cm were taken on November 15, 1983 from 17-year-old ligneous parent plants 2.5 m high. They were stored in a cellar maintained at 2°C in a mixture of peat (50%) and sand (50%). On April 21, 1984, they were placed in a frame; 216 rooted cuttings were potted and returned to the frame in the spring of 1985. During the summer, they grew nearly 50 cm. Before being shipped in the spring of 1986, the plants were cut back because of frost damage.

Inclusion in test network: Young plants 25 to 35 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Between 5% and 10% of the plants died on transplanting at seven of the eight sites.

Winter damage

Region 1

No mortality due to frost damage was recorded in region 1.

At the L'Assomption site on sand, frost damage on the stem tips was evident on almost all the plants four years out of five, while at the site on clay, this damage was apparent during the first and last winters.

At Sainte-Clotilde, this type of frost damage was evident the second, fourth and last winters.

Region 2

At the Sainte-Foy site, frost damage was particularly severe during the second winter, since all the plants suffered damage on the previous year's shoot (58%), on the old wood (5%) or on the above-ground portion exposed above the level of snow cover (37%). Rodents damaged all the plants during the third winter. The other winters, frost damage on the previous year's shoot was the most frequent damage, in addition to frost damage on the stem tips.

At Deschambault, mechanical breakage caused by weather conditions (snow, ice and wind) damaged all the plants during the second winter. Frost damage on the previous year's shoot was observed during the third and fourth winters, affecting 75% and 58% of the plants. The other plants suffered frost damage on the stem tips every year.

At La Pocatière, poor pedological conditions resulted in the death of 50% of the plants during the first three winters. Those that survived suffered frost damage on the previous year's shoot, mainly the last two winters, and frost damage on the stem tips.

Region 3

A number of plants died at Normandin, specifically 40%, 8% and 11% during the first, second and fourth winters. The plants were affected every year by frost damage on the previous year's shoot or down to the level of snow cover.

As at the preceding site, mortality affected 45%, 11% and 50% of the plants the first, third and last winters. Frost damage was apparent on the previous year's shoot or on the entire above-ground portion.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 2.40 m R2 = 1.34 m R3 = 1.30 m

Growth in region 1 was clearly better.

Categories

The average height of the shrubs after five years varied from one station to another:

2.01 m and + : Sainte-Clotilde, L'Assomption on sand
and L'Assomption on clay
1.51 - 2.00 m: La Pocatière
1.01 - 1.50 m: Normandin, Deschambault and
Kapuskasig
1.00 m and - : Sainte-Foy

The plants at Sainte-Foy were cut back to ground level the fourth year as a result of damage caused by field mice.

Effect of pruning

Pruning was severe to very severe, depending on the year and the site. It resulted in a reduction in height of 20% to 30% in region 1 and 50% to 70% at the other sites.

***Tamarix ramosissima* Ledeb.**

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.48 m R2 = 1.15 m R3 = 0.90 m

The width was unchanged during the last two or three years at most of the sites.

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.51 m and + : L'Assomption on sand and Sainte-Clotilde
- 1.01 - 1.50 m: La Pocatière, Deschambault and L'Assomption on clay
- 1.00 m and - : Normandin, Kapuskasing and Sainte-Foy

Flowering

In region 1, the flowering period began between June 15 and 25 and lasted for 80 to 100 days. It occurred a week later at Deschambault. The severe pruning carried out at Sainte-Foy delayed growth and consequently flowering by at least a month. At the sites in region 3, the first flowers were observed around August 17. When the flowers appear at the end of the season, the flowering period is reduced to 30 or 40 days.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

Growth was clearly better in the Montreal region; 90% of the plants attained a height of 1.00 m or more after two years at the L'Assomption on sand and Sainte-Clotilde sites. At the other sites, a significantly longer period, of up to four years, was necessary to obtain

plants of comparable height. Transplanting this species is a delicate operation.

Use

This species, assigned a zone rating of 3 by Buckley, exhibited serious frost damage at all the sites located in climatic zones 2 and 4. In light of the serious damage which occurred in zone 2 and the high mortality, this species cannot be recommended under climatic conditions which affect it so severely. Under these conditions, the plants which survive are considered woody perennials which must be cut back to the ground every year, which considerably reduces their flowering period. Nonetheless, the less severe damage in zone 4 makes it possible to use this plant in this zone. However, one must expect to have to prune annually and, depending on the year, to obtain a shorter flowering period. Since there was no site in zone 3, we cannot modify the zone rating of this species.

BIBLIOGRAPHICAL REFERENCES

- 4, 13, 27, 40, 47, 49, 50, 56

WRITTEN BY

- Claude Richer, Agr.*
- Jacques-André Rioux, Agr.*
- Jacques Côté, Biol.*

Table 1: Frequency of winter damage observed on *Tamarix ramosissima* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	58	40						1	1		42
L'Assomption-sand	29	71									71
Sainte-Clotilde	53	47									47
REGION 2											
Deschambault	0	40	33					27			100
Sainte-Foy	0	33	38	7		1	1		20		100
La Pocatière	0	39	52			9					100
REGION 3											
Normandin	20		48	20		12					80
Kapuskasing	0		36	2	41	21					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 splitting |
| 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 types 3, 9 and 14 occurred for this species.

Table 2: Breakdown of *Tamarix ramosissima* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51-100	95	11	0	0	0	100	84	0	0	0	52	0	0	0	0
101-150	0	89	58	0	0	0	16	100	33	8	48	19	0	0	8
151-200	0	0	42	25	8	0	0	0	67	33	0	81	25	0	9
201-250	0	0	0	58	33	0	0	0	0	42	0	0	75	25	33
251-300	0	0	0	17	59	0	0	0	0	17	0	0	0	75	42
301 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8

Height (cm)	REGION 2															REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90					
0-50	40	11	8	17	17	63	0	0	0	0	45	36	0	0	0	5	33	0	0	0	30	9	0	0	0					
51-100	60	74	67	67	50	37	100	33	0	0	55	64	50	22	0	95	33	22	11	0	70	73	67	13	25					
101-150	0	15	25	16	25	0	0	67	75	67	0	0	50	56	44	0	34	45	67	37	0	18	33	75	75					
151-200	0	0	0	0	8	0	0	0	25	33	0	0	0	22	44	0	0	33	22	63	0	0	0	12	0					
201-250	-	-	-	-	-	-	-	-	-	-	0	0	0	0	12	-	-	-	-	-	-	-	-	-	-	-				
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
301 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

Table 3: Breakdown of *Tamarix ramosissima* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	95	0	0	0	0	90	42	0	0	0	19	0	0	0	0
51-100	5	73	17	0	8	10	58	50	50	42	81	10	8	0	17
101-150	0	27	33	25	0	0	0	42	50	58	0	90	50	59	33
151-200	0	0	50	33	58	0	0	8	0	0	0	0	42	41	50
201 and +	0	0	0	42	34	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	37	17	33	17	100	26	8	0	0	100	100	10	0	0	100	75	11	22	0	70	50	50	0	0
51-100	0	63	83	67	75	0	74	58	59	8	0	0	70	63	11	0	25	89	55	63	30	50	50	87	63
101-150	0	0	0	0	8	0	0	34	41	75	0	0	20	37	66	0	0	0	23	37	0	0	0	13	37
151-200	-	-	-	-	-	0	0	0	0	17	0	0	0	0	11	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	12	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis L. (C)

See colour plate

Family	:	Cupressaceae
English name	:	American arborvitae, white cedar (incorrectly called cedar)
French name	:	Thuya occidental, thuya du Canada
Synonym	:	<i>T. obtusa</i> , <i>T. odorata</i> Marsh.
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree normally reaches a height of 15 m and a diameter of 30 cm, but under good conditions can grow as high as 25 m and as wide as 1 m. The growth habit is conical or columnar when the tree is young and standing alone, becoming wider as it ages. The branches are short, spreading or ascending at the bottom of the tree and turning upwards toward the tips.

The trunk is often twisted at the base and has a rough appearance. It is often divided into two or more secondary stems almost equal in size.

The thin, reddish-brown bark is fissured in the longitudinal direction of the trunk, creating narrow, fibrous ridges.

The branches grow in the shape of a fan and are yellowish-green on both sides. The foliage is dense and the leaves are in four overlapping rows. The young shoots are light green, flattened and fairly fine. They are more or less dark green on the upper surface and light green below. The central branchlets have conspicuous glands.

The cones are small, oval, paler green than the foliage and are 5 to 10 mm long. They grow at the tip of the branches, mature in late summer and fall the following year. They are composed of four or five pairs of scales, of which only two pairs are fertile. For each fertile scale, there are two flattened seeds with a notched wing.

The tree is kept standing by the spreading but shallow roots and a pronounced swelling or widening of the base of the trunk.

The wood is light, soft, weak and has a characteristic odour. The heartwood is light brown and resistant to decay. The sapwood is almost white.

ORIGIN AND DISTRIBUTION

This indigenous species is found throughout the Great Lakes-St. Lawrence Forest Region, in most of the Acadian Forest Region, as well as in the central and eastern portions of the Boreal Forest Region about as far north as James Bay. It grows naturally in pure stands in mixed forests, on Cambrian rocks, along cliffs, on rocky shores and on river banks. It is often found with black spruce and larch in shallow sphagnum bogs, but it grows very slowly there. On moist soils, where it grows to its greatest size, it is commonly found with white pine, birch, hemlock, silver maple, black ash and white elm.

It was introduced in Europe around 1534.

USE

Ornamental: This species is often used to make hedges, screens and secondary windbreaks, in clumps or simply standing alone.

Wood use: It is used to make posts, poles, shingles as well as canoes and other boats.

Medical: This species is frequently used in Amerindian and folk medicine.

REQUIREMENTS

This species prefers limestone subsoils but adapts to different environments and exposures. It can grow in swampy locations, usually where the water is only moderately acidic.

Its foliage, like that of most conifers, is sensitive to winter desiccation; direct exposure to the sun in the spring should be avoided. To prevent desiccation, this species must be watered generously in the fall.

PATHOLOGY

To our knowledge, this species is not particularly affected by any disease. The thuja bark beetle (*Phloeosinus* sp.) can cause withering and yellowing of the branches of the species and its cultivars.

PROPAGATION

Seedlings: After harvesting, the cones must be dried for a few weeks in a well-ventilated location. The seeds should separate from the cones during this treatment; otherwise, the cones must be stirred until the seeds are extracted. When stored at 2°C or 3°C, the seeds can remain viable for five years. They quickly lose their germinative capacity if stored under conditions that are too moist or too warm.

Germination occurs naturally in moist soil.

Stored seeds must be stratified for 30 to 60 days at 4°C or 5°C.

Propagation by cuttings: This species is generally propagated by hardwood cuttings during the winter.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

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

Propagation technique: Cuttings of 15 cm were taken on December 19, 1983 and treated with a solution of 10,000 ppm IBA. They were placed in a substrate composed of peat and perlite and placed under mist for a duration of 15 seconds every 15 minutes. The rooting rate was 75%. In May and June 1984, the rooted cuttings were potted in Fertil Pots[®] and placed outside on July 3. The winter survival rate was 100%. In May 1985, the plants were wrapped and placed in a cold store until they were shipped a few days later.

Inclusion in test network: Young plants 12 to 14 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

This species was very little affected by the weather conditions during testing and damage was light and infrequent.

Mortality was occasional and not significant.

Region 1

No damage occurred at the L'Assomption on sand and Sainte-Clotilde sites. In addition, only one plant died following the second winter at L'Assomption on clay.

At Sainte-Anne-de-Bellevue, one plant suffered damage on the previous year's shoot the first winter and 42% of the trees exhibited frost damage on the stem tips following the fourth winter.

Region 2

At Sainte-Foy, one year out of two, a certain percentage of plants (33% and 50%) exhibited frost damage on the stem tips. Following the same winters, the plants at La Pocatière suffered browning of the foliage.

At Deschambault, the first winter caused the death of one plant and frost damage on the stem tips of 15% of the plants. The last winter, one plant out of four suffered mechanical damage.

Region 3

At Normandin, one plant died following the fourth winter; this plant had exhibited no growth the previous year. Only 17% of the plants suffered frost damage on the stem tips following the third winter.

At Kapuskasing, the plants that died were in the same replication: this damage may be attributable to poor recovery of the plants or to less favourable edaphic conditions. The living plants suffered no damage.

***Thuja occidentalis* L. (C)**

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.28 m R2 = 1.07 m R3 = 0.91 m

The two L'Assomption sites brought down the average for region 1.

Categories

The average height of the trees after five years varied from one site to another:

1.26 - 1.50 m: Sainte-Clotilde and Sainte-Anne-de-Bellevue
 1.01 - 1.25 m: Sainte-Foy, L'Assomption on sand, Deschambault and L'Assomption on clay
 1.00 m and - : La Pocatière, Normandin and Kapuskasing

Growth was much slower at the sites on clay soil.

Effect of pruning

Only pruning for shaping was necessary.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 0.88 m R2 = 0.92 m R3 = 0.82 m

The sites on clay soils brought down their respective regional averages.

Categories

The average width of the trees after five years varied from one site to another:

1.01 - 1.10 m: Sainte-Clotilde
 0.91 - 1.00 m: Sainte-Anne-de-Bellevue, La Pocatière and Sainte-Foy
 0.81 - 0.90 m: L'Assomption on sand
 0.71 - 0.80 m: Deschambault
 0.61 - 0.70 m: Kapuskasing, Normandin and L'Assomption on clay

The plants at the last three sites were clearly less wide than those at the other sites.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After three years of growth, 60% or more of the plants at Sainte-Clotilde, Sainte-Anne-de-Bellevue and Sainte-Foy had attained a height of more than 75 cm. A fourth year was necessary at the L'Assomption sites on sand and on clay as well as at Deschambault and La Pocatière. At Normandin and Kapuskasing, it took an additional year to obtain plants of comparable height.

The production of this species is faster south of Montreal and would be more competitive there than elsewhere. However, its production is possible throughout Quebec, although production costs would be higher.

Use

The zone rating of 3 assigned to this species in the literature is underestimated since the plants did not exhibit any serious damage at Kapuskasing (zone 2a). The mortality observed there was low and mainly related to the pedological conditions of the plot. A zone rating of 2a remains conservative and the behaviour of this species during testing suggests that it could even be used in zone 1b.

Occasionally, this species can exhibit browning of the foliage.

Heavy soils slow its growth.

BIBLIOGRAPHICAL REFERENCES

2, 3, 14, 21, 24, 44, 46, 51, 56, 60, 65, 71, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	99					1					1
L'Assomption-sand	100										0
Ste-Anne-de-Bellevue	92	8	1								9
Sainte-Clotilde	100										0
REGION 2											
Deschambault	91	3				1		5			9
Sainte-Foy	83	17									17
La Pocatière	80									20	20
REGION 3											
Normandin	95	3				2					5
Kapuskasing	94					4	2				6

- ^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 splitting |
| 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 types 3, 6, 7 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue														
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89										
0-25	100	10	0	0	0	95	58	0	0	0	95	0	0	0	0	53	0	0	0	0										
26-50	0	90	67	8	0	5	42	45	0	0	5	24	0	0	0	47	53	0	0	0										
51-75	0	0	33	33	8	0	0	55	36	0	0	76	33	8	0	0	47	33	0	0										
76-100	0	0	0	42	25	0	0	0	64	55	0	0	67	17	8	0	0	59	33	0										
101-125	0	0	0	17	25	0	0	0	0	45	0	0	0	67	17	0	0	8	42	0										
126-150	0	0	0	0	34	-	-	-	-	-	0	0	0	8	25	0	0	0	25	58										
151-175	0	0	0	0	8	-	-	-	-	-	0	0	0	0	50	0	0	0	0	42										
Height (cm)	REGION 2															REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-25	52	5	0	0	0	72	30	0	0	0	95	24	8	0	0	95	19	0	0	0	89	50	10	0	0					
26-50	48	24	8	0	0	28	50	33	17	0	5	76	59	9	0	5	76	75	18	0	11	50	80	33	11					
51-75	0	66	33	8	0	0	20	42	17	25	0	0	33	8	8	0	5	25	64	18	0	0	10	56	11					
76-100	0	5	59	42	17	0	0	25	33	17	0	0	0	75	67	0	0	0	18	64	0	0	0	11	45					
101-125	0	0	0	33	42	0	0	0	33	33	0	0	0	8	17	0	0	0	0	9	0	0	0	0	33					
126-150	0	0	0	17	41	0	0	0	0	25	0	0	0	0	8	0	0	0	0	9	-	-	-	-	-					
151-175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					

Table 3: Breakdown of *Thuja occidentalis* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	100	48	0	0	0	100	89	0	0	0	100	14	0	0	0	68	0	0	0	0
26-50	0	52	100	8	0	0	11	100	82	27	0	86	25	0	0	32	95	33	0	0
51-75	0	0	0	92	8	0	0	0	18	45	0	0	75	25	0	0	5	67	25	8
76-100	0	0	0	0	75	0	0	0	0	28	0	0	0	75	50	0	0	0	75	59
101-125	0	0	0	0	17	-	-	-	-	-	0	0	0	0	50	0	0	0	0	33
126-150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	66	5	0	0	0	67	30	8	0	0	100	19	8	0	0	100	10	17	0	0	89	19	0	0	0
26-50	34	66	17	0	0	33	70	34	25	8	0	81	67	8	0	0	90	75	45	27	11	75	90	33	22
51-75	0	29	83	67	8	0	0	58	50	33	0	0	25	17	0	0	0	8	45	45	0	6	10	67	22
76-100	0	0	0	33	42	0	0	0	25	59	0	0	0	75	50	0	0	0	10	28	0	0	0	0	56
101-125	0	0	0	0	42	-	-	-	-	-	0	0	0	0	50	-	-	-	-	-	-	-	-	-	-
126-150	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis L. (C)

This species was used as a control.

PATHOLOGY

The thuja bark beetle (*Phloeosinus canadensis*) is a small coleopteron which feeds on the bark. The damage is visible on shoots approximately two years old.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 400 cuttings of 15 cm were taken on December 13, 1991 from eight-year-old parent plants approximately 1.20 m high and 60 cm wide. They were dipped for five seconds in a solution of 4,000 ppm IBA and 50% ethanol, after being nicked on the basal portion of the stem. They were placed in trays with individual cells (45 cells), filled with a substrate composed of Pro-Mix[®] (33%) and sand (67%), then placed under mist for a duration of five seconds every hour. The temperature of the heating cables was set to 25°C. A weekly fungicidal treatment containing Benomyl-Captan[®] was applied for the entire propagation period. The rooting rate was 75% after three months. The application of mist was gradually discontinued and the plants were placed under shade and fertilized with a solution of 10-52-10 fertilizer at the recommended rate. On May 19, 1992 they were transplanted to the nursery. A soluble fertilizer (20-20-20) was applied according to the recommended dose. On October 25, the plants were dug up, puddled and heeled in. In mid-April 1993, they were wrapped and stored in a cellar until they were shipped in May.

Inclusion in test network: Young plants 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Only one plant died during testing, at Kapuskasing. The most frequent damage was browning of the foliage at three sites and occasional frost damage on the stem tips at a few sites.

Region 1

No damage occurred at the L'Assomption on sand and Sainte-Clotilde sites.

At L'Assomption on clay, the third winter, one plant suffered frost damage on the stem tips and the trunk of another plant suffered sunscald.

Region 2

At Deschambault, mechanical breakage caused by the weight of the snow was observed on one plant following the second winter and on another plant the fourth winter.

At Sainte-Foy, 95% or more of the plants were not affected the first, second and fourth winters. The third winter, 92% of the plants suffered frost damage on the stem tips and, the last winter, 84% of the plants suffered browning of the foliage.

At La Pocatière, damage from browning of the foliage was common and almost all the plants were affected during the first, third and fourth winters. The fifth winter, 33% of the plants exhibited frost damage on the stem tips.

Region 3

At Normandin, damage was limited to frost damage on the stem tips on only two plants the second winter.

At Kapuskasing, 70% to 100% of the plants did not suffer any damage the first four winters: damage was limited to frost damage on the stem tips on 30% of the plants the first winter and browning of the foliage on 17% of the plants the fourth winter. As well, the last winter, 91% of the plants exhibited browning. One plant died the fourth winter.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.53 m R2 = 1.42 m R3 = 1.06 m

The plants at the L'Assomption on clay and La Pocatière sites brought down their respective regional averages.

On clay soils, annual growth was generally poorer the first two years compared to the other sites, where the period of establishment of the trees was one year.

Categories

The average height of the trees after five years varied from one station to another:

1.51 - 2.00 m: Sainte-Clotilde, Deschambault, Sainte-Foy and L'Assomption on sand
1.01 - 1.50 m: Normandin and L'Assomption on clay
1.00 m and - : La Pocatière and Kapuskasing

Effect of pruning

Only the portions damaged during the winter were pruned.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 0.94 m R2 = 1.16 m R3 = 1.9 m

The L'Assomption on clay and La Pocatière sites brought down their respective regional averages.

Categories

The average width of the trees after five years varied from one station to another:

1.26 m and + : Sainte-Foy
1.01 - 1.25 m: Deschambault, Sainte-Clotilde and Normandin
0.76 - 1.00 m: L'Assomption on sand, La Pocatière and Kapuskasing
0.50 - 0.75 m: L'Assomption on clay

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and the width obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

Obtaining trees 1 m high or taller required three years of production at the sites where growth was fastest: 92% of the plants at Sainte-Foy, 75% of those at Sainte-Clotilde, 50% of those at L'Assomption on sand and 42% of those at Deschambault attained this height.

At Normandin, just over half the trees had attained this height after four years of growth, while five years were required at the other three sites.

Use

The zone rating of 3 assigned to this species in the literature is underestimated since the plants did not exhibit any serious damage at Kapuskasing (zone 2a). The mortality observed there was low and mainly related to the pedological conditions of the plot. A zone rating of 2a remains conservative and the behaviour of this species during testing suggests that it could even be used in zone 1b.

Occasionally, this species can exhibit browning of the foliage.

Heavy soils slow its growth.

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	96	2					2				4
L'Assomption-sand	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	97							3			3
Sainte-Foy	63	18						2		17	37
La Pocatière	39	6								55	61
REGION 3											
Normandin	98	2									2
Kapuskasing	70	6				2				22	30

- ^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 splitting |
| 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 types 3, 4, 5, 6, 7 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	95	0	0	0	0	95	62	8	0	0	48	0	0	0	0
51-100	5	100	50	0	0	5	38	92	75	17	52	100	25	0	0
101-150	0	0	50	100	42	0	0	0	25	67	0	0	75	50	8
151-200	0	0	0	0	58	0	0	0	0	16	0	0	0	50	75
201 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	62	0	0	0	0	80	0	0	0	0	100	95	42	25	0	90	76	25	0	0	100	95	42	0	0
51-100	38	86	8	0	0	20	100	58	8	0	0	5	58	75	58	10	24	75	42	25	0	5	58	92	45
101-150	0	14	92	83	33	0	0	42	67	42	0	0	0	0	42	0	0	0	58	75	0	0	0	8	55
151-200	0	0	0	17	67	0	0	0	25	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	0	0	0	0	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	43	0	0	0	0	67	0	0	0	0	0	0	0	0	0
26-50	57	48	0	0	0	33	100	67	0	33	100	33	0	0	0
51-75	0	52	92	0	0	0	0	33	75	42	0	67	33	0	0
76-100	0	0	8	67	75	0	0	0	25	25	0	0	67	42	8
101-125	0	0	0	33	25	-	-	-	-	-	0	0	0	58	58
126-150	-	-	-	-	-	-	-	-	-	-	0	0	0	0	34

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	0	0	0	0	0	0	0	0	0	0	29	0	0	0	0	57	9	0	0	0	24	5	0	0	0
26-50	100	0	0	0	0	100	5	8	0	0	71	90	33	0	0	43	86	25	8	0	76	90	25	0	0
51-75	0	100	8	0	0	0	90	25	8	0	0	10	34	50	17	0	5	42	17	8	0	5	75	25	0
76-100	0	0	92	58	0	0	5	58	75	17	0	0	33	42	50	0	0	33	58	17	0	0	0	67	45
101-125	0	0	0	42	50	0	0	9	17	25	0	0	0	8	17	0	0	0	17	58	0	0	0	8	55
126-150	0	0	0	0	50	0	0	0	0	58	0	0	0	0	16	0	0	0	0	17	-	-	-	-	-

Thuja occidentalis**'Fastigiata'**

See colour plate

Family	:	Cupressaceae
English name	:	Columnar American arborvitae, pyramidal arborvitae
French name	:	<i>Thuja occidentalis fastigié</i>
Synonym	:	<i>Thuja occidentalis 'Stricta'</i>
Note	:	This cultivar is often mistakenly called 'Columnaris' or 'Pyramidalis'

BOTANICAL DESCRIPTION

This tree with a columnar growth habit can attain a height of 9 m. The lateral branches are short and ascending and produce a denser, more compact appearance than the type species.

The foliage is light green, dense, compact, and the distribution of the branchlets is more regular.

ORIGIN AND DISTRIBUTION

This cultivar was selected around 1867 in the United States using seeds from the type species.

USE

Ornamental: This cultivar is used in clumps, standing alone or as a pruned hedge at least 1.5 m high.

REQUIREMENTS

It grows more slowly than the type species. Like the latter, this cultivar prefers moist soils and sunny exposures.

PATHOLOGY

To our knowledge, no disease particularly affects this cultivar. The thuja bark beetle (*Phloeosinus* sp.) can cause withering and yellowing of the branches of *Thuja* and its cultivars.

Plants originating from outside Quebec must be checked for possible infestations, particularly with Fletcher scale on *Thuja*.

PROPAGATION

Propagation by cuttings: Heel cuttings, taken from the year's wood between November and March, take root very well.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: 300 cuttings of 20 cm were taken on December 1, 1984 from 20-year-old parent plants. They were treated with a solution of 4,000 ppm IBA and placed in a mist propagator with a diurnal watering frequency of six seconds every nine minutes. The temperature of the heating cables varied between 20°C and 25°C. The substrate was composed of sand, perlite and peat (2:1:1). The rooting rate was 90% in February 1985. The cuttings were potted in March and kept in a greenhouse until May. They were wrapped and placed in the cellar until they were shipped, a few days later.

Inclusion in test network: Young plants 15 to 18 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)**Winter damage**

Most of the winter damage occurred following the fourth winter.

Mortality was infrequent and was attributable to successive damage caused by rodents at Sainte-Foy and to damage caused by harsh weather at Kapuskasing.

Region 1

No damage was observed at Sainte-Clotilde during the entire testing period and, at Sainte-Anne-de-Bellevue, the plants suffered frost damage on the stem tips only during the fourth winter.

At L'Assomption on clay, the plants were undamaged the first three years and one plant died following the fourth winter. The same winter, all the plants in replications 2 and 3 at L'Assomption on sand suffered frost damage on the trunk and these same plants exhibited browning of the foliage the following winter.

Region 2

At La Pocatière, all the plants were undamaged following the first and third winters. The other years, 50% to 75% of the plants suffered browning of the foliage.

At Sainte-Foy, damage was very similar to that observed at La Pocatière, with the addition of the damage caused successively by rodents the first three winters, resulting in the death of the plants the fourth season.

At Deschambault, more than 70% of the plants were undamaged every year. Frost damage on the stem tips was observed the first winter on 30% of the plants and one plant suffered frost damage down to ground level following the third winter.

Region 3

At Normandin, damage was limited to frost damage on the stem tips on 25% and 8% of the plants following the third and fourth winters.

At Kapuskasing, a few plants died during the third and fourth winters. In addition, 89% of the plants exhibited browning of the foliage following the last winter. Despite this, 80% or more of the plants were undamaged during the first four years.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 1.26 m R2 = 1.15 m R3 = 1.04 m

Categories

The average height of the trees after five years varied from one site to another:

1.26 m and +: Sainte-Anne-de-Bellevue, L'Assomption on sand, Sainte-Clotilde and Deschambault
 1.01 - 1.25 m: Sainte-Foy, Normandin and La Pocatière
 1.00 m and -: L'Assomption on clay and Kapuskasing

The height of the trees was fairly uniform within the same region, but at five stations, one or two plants exhibited 50% less growth than the other plants.

By the second year, growth of the plants at the sites on clay soil was poorer. This difference increased over the years.

Effect of pruning

Pruning was almost nil.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 0.65 m R2 = 0.55 m R3 = 0.49 m

The L'Assomption site on clay was eliminated from the regional average because growth in width there was very poor.

Width is a good indicator of the growth of the plants.

Categories

The average width of the trees after five years varied from one site to another:

0.61 - 0.70 m: Sainte-Clotilde, Sainte-Anne-de-Bellevue and L'Assomption on sand
 0.51 - 0.60 m: Sainte-Foy, Deschambault, La Pocatière and Normandin
 0.41 - 0.50 m: Kapuskasing and L'Assomption on clay

Width was very uniform from one site to another within the same region and the differences between the sites were similar to the results obtained for height.

***Thuja occidentalis* 'Fastigiata'**

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After three years of growth, between 80% and 90% of the plants at Sainte-Anne-de-Bellevue and Sainte-Foy had attained a height of more than 75 cm, while nearly 50% of those at Sainte-Clotilde and Deschambault were of comparable height. It took a fourth year at the other sites for 80% or more of the trees to reach this height. At Kapuskasing, a fifth year was necessary for 80% of the trees to attain a height greater than 75 cm.

This species is sold according to a single criterion: height.

Use

According to Sherk and Buckley, this cultivar has the same zone rating as all the cultivars of *T. occidentalis*, namely 3. This cultivar exhibited very little damage at Kapuskasing other than a certain percentage of mortality during the third and fourth winters. It appears to be a little less hardy than the type species and a zone rating of 2a accurately reflects its potential.

At certain sites, particularly at La Pocatière, damage from browning of the foliage was apparent. Snow cover may be a factor, as well as drying winds. This cultivar should be protected from wind and sunscald.

BIBLIOGRAPHICAL REFERENCES

3, 13, 14, 20, 23, 27, 49, 50, 60, 68, 79, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Fastigiata' from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
		2	4	6	7	8	5 and 9	10	11	14		
REGION 1												
L'Assomption-clay	98					2					2	
L'Assomption-sand	63	4					13			10	27	
Ste-Anne-de-Bellevue	80	20									20	
Sainte-Clotilde	100										0	
REGION 2												
Deschambault	91	7			2						9	
Sainte-Foy	65	21				4			10		35	
La Pocatière	62									38	38	
REGION 3												
Normandin	93	7									7	
Kapuskasing	69					7	2			22	31	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 4, 6 and 10 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Fastigiata' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0					
11-25	76	0	0	0	0	95	5	0	0	0	81	0	0	0	0	14	0	0	0	0					
26-50	24	71	0	0	0	5	95	9	0	0	5	43	8	0	0	86	5	0	0	0					
51-75	0	29	92	0	0	0	0	91	9	0	0	57	50	25	0	0	95	17	0	0					
76-100	0	0	8	50	0	0	0	0	91	55	0	0	42	8	25	0	0	83	0	0					
101-125	0	0	0	42	50	0	0	0	0	45	0	0	0	67	8	0	0	0	100	8					
126-150	0	0	0	8	42	-	-	-	-	-	0	0	0	0	59	0	0	0	0	84					
151-175	0	0	0	0	8	-	-	-	-	-	0	0	0	0	8	0	0	0	0	8					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-25	48	0	0	0	0	48	5	8	0	0	81	0	0	0	0	62	0	0	0	0	85	75	0	0	0
26-50	52	17	9	0	0	52	28	9	8	0	19	67	25	0	0	38	67	42	8	0	15	25	55	20	0
51-75	0	83	0	9	0	0	67	25	8	8	0	33	67	17	0	0	33	58	0	8	0	0	45	30	11
76-100	0	0	81	9	18	0	0	58	9	8	0	0	8	50	33	0	0	0	84	0	0	0	0	50	33
101-125	0	0	10	82	64	0	0	0	58	25	0	0	0	33	67	0	0	0	8	92	0	0	0	0	56
126-150	0	0	0	0	18	0	0	0	17	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151-175	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Fastigiata' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0
11-20	100	33	0	0	0	95	76	0	0	0	95	0	0	0	0	90	0	0	0	0
21-30	0	67	33	0	0	0	19	82	0	0	5	57	0	0	0	10	86	0	0	0
31-40	0	0	50	0	0	0	0	18	73	45	0	43	8	0	0	0	14	33	0	0
41-50	0	0	17	75	25	0	0	0	27	46	0	0	75	42	9	0	0	67	33	0
51-60	0	0	0	25	8	0	0	0	0	9	0	0	17	33	33	0	0	0	58	25
61-70	0	0	0	0	33	-	-	-	-	-	0	0	0	25	34	0	0	0	9	67
71-80	0	0	0	0	25	-	-	-	-	-	0	0	0	0	8	0	0	0	0	8
81-90	0	0	0	0	9	-	-	-	-	-	0	0	0	0	16	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	0	0	0	0	0	0	5	8	0	0	0	0	0	0	0	19	0	0	0	0	15	0	0	0	0
11-20	57	0	0	0	0	48	0	0	8	0	90	14	0	0	0	81	5	0	8	0	80	30	0	0	0
21-30	43	50	9	0	0	52	67	9	0	8	10	81	58	0	0	0	42	42	0	0	5	65	64	20	0
31-40	0	50	56	55	9	0	28	33	17	8	0	5	42	17	0	0	48	58	83	8	0	5	36	80	11
41-50	0	0	35	45	19	0	0	50	50	0	0	0	0	75	17	0	5	0	9	42	0	0	0	0	67
51-60	0	0	0	0	36	0	0	0	25	67	0	0	0	8	83	0	0	0	0	42	0	0	0	0	22
61-70	0	0	0	0	27	0	0	0	0	17	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-
71-80	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81-90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis 'Little Champion'

See colour plate

Family	:	Cupressaceae
English name	:	Little Champion American arborvitae
French name	:	Thuja occidentalis 'Little Champion'
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This dwarf shrub with a globular, wide growth habit can attain a height of 1.0 m and a width of 1.20 m. The foliage is coarse and light green. The tips of the branches turn brown during the winter. The middle and lower branchlets are horizontal.

ORIGIN AND DISTRIBUTION

This cultivar was developed in Canada by the McConnell company. It was selected from seeds in 1936 and marketed in 1956.

USE

Ornamental: This cultivar can be used standing alone or in clumps with other shrubs.

REQUIREMENTS

This is a slow-growing cultivar. Like all *Thuja*, this cultivar prefers a sunny exposure and rich, well-drained soil.

PATHOLOGY

To our knowledge, no disease appears to affect this small conifer.

PROPAGATION

Propagation by cuttings: Heel or semi-hard cuttings can be taken in the winter or during the summer.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 400 cuttings of 15 cm were taken on August 1, 1985 and dipped for five seconds in a solution of 5,000 ppm IBA and 50% ethanol. They were placed in a greenhouse in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 73% after seven weeks. The plants were potted in Fertil Pots® in September and October. They were wrapped on April 8, 1986, then placed in a cold store at 4°C until they were shipped on April 18.

Inclusion in test network: Young plants 15 to 20 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

No damage was observed at the L'Assomption site on sand. At the site on clay, one plant died during the first winter, two plants were damaged by rodents the second winter and one of them died the following year. No other frost damage was observed.

At Sainte-Clotilde, 20% of the plants died the first winter and no other damage occurred subsequently.

Region 2

At Sainte-Foy, 10% of the plants suffered browning of the foliage during the first winter. No other damage was observed.

At Deschambault, no damage was observed the first three winters. However 67% of the plants suffered mechanical breakage during the fourth winter and one plant exhibited signs of browning of the foliage.

At La Pocatière, damage was serious the first four winters; 57% of the plants suffered browning the first winter, 100% the third and 80% the fourth winter. Some 10% of the plants died during the second winter and 5% died following mechanical breakage.

Region 3

At Normandin, some plants suffered damage during the first four winters. In addition, 33% of the plants died the last winter and these plants were all located in the same plot.

At Kapuskasing, 90% of the plants exhibited frost damage on the stem tips the first winter and 10% died. No damage occurred the following two winters, while 33% of the plants exhibited desiccated foliage following the fourth winter and 8% died the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 63.6 cm R2 = 60.0 cm R3 = 52.5 cm

The plants in region 3 were slightly shorter than those in the other regions.

Categories

The average height of the shrubs after five years showed little variation from one station to another:

71 cm and + : L'Assomption on sand
 61 - 70 cm: Deschambault, Sainte-Foy and Sainte-Clotilde
 51 - 60 cm: Normandin and L'Assomption on clay
 41 - 50 cm: Kapuskasing and La Pocatière

Growth on clay soils was poorer.

Effect of pruning

No pruning was required for the plants of this cultivar.

Growth in width

After five years, the average width for each region was:

R1 = 76.4 m R2 = 78.3 m R3 = 69.3 m

Categories

The average width of the shrubs after five years varied from one station to another:

81 cm and + : Sainte-Clotilde, Sainte-Foy and Deschambault
 76 - 80 cm: L'Assomption on sand
 71 - 75 cm: Normandin
 66 - 70 cm: -
 61 - 65 cm: Kapuskasing, L'Assomption on clay and La Pocatière

The plants grown on clay soils were not as wide.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined width and height.

Production

This cultivar can be produced competitively in regions 1 and 2, provided that the pedological conditions are favourable. The mortality observed occurred mainly at the sites with heavier soils. In addition, after suffering repeated damage from browning of the foliage, the plant seems to weaken significantly.

After two years of growth, 90% or more of the plants located at the L'Assomption on sand, Sainte-Clotilde, Deschambault and Sainte-Foy sites had attained a height of between 26 and 50 cm. A third year was necessary at the other sites for 75% or more of the plants to reach a comparable height.

***Thuja occidentalis* 'Little
Champion'**

Use

Buckley did not assign any zone rating to this cultivar, implying that its rating was 3, like the type species. Based on our results, we can assign a rating of 2b to this cultivar, taking into account the fact that it must be grown on a suitable, light soil and that drainage must be adequate. In zone 2a, plant survival was good, but the very slow growth of the plants did not make it possible to evaluate the cold resistance potential of the above-ground portion exceeding the level of snow cover.

BIBLIOGRAPHICAL REFERENCES

4, 13, 14, 100

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Little Champion' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage										Cumulative damage
		WINTER DAMAGE ^a										
	1	2	4	6	7	8	5 and 9	10	11	14		
REGION 1												
L'Assomption-clay	93					3			4		7	
L'Assomption-sand	100										0	
Sainte-Clotilde	96					4					4	
REGION 2												
Deschambault	81							17		2	19	
Sainte-Foy	98									2	2	
La Pocatière	51					2				47	49	
REGION 3												
Normandin	89	4				7					11	
Kapuskasig	71	18				4				7	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 splitting |
| 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 types 3, 4, 5, 6, 7 and 9 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Little Champion' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	5	0	0	0	100	44	25	0	0	95	0	0	0	0
26-50	0	95	75	8	0	0	56	75	100	55	5	100	83	0	0
51-75	0	0	25	92	50	0	0	0	0	45	0	0	17	100	92
76-100	0	0	0	0	50	-	-	-	-	-	0	0	0	0	8
101-125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	89	11	8	0	0	100	0	0	0	0	100	100	0	0	0	95	100	25	0	0	100	78	17	0	0
26-50	11	89	83	8	8	0	100	100	0	0	0	0	100	100	90	5	0	75	75	17	0	22	83	100	67
51-75	0	0	9	92	92	0	0	0	100	92	0	0	0	0	10	0	0	0	25	83	0	0	0	0	33
76-100	-	-	-	-	-	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-125	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Little Champion' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	10	0	0	0	78	0	8	0	0	71	0	0	0	0
26-50	0	90	83	17	0	22	100	92	9	9	29	100	25	0	0
51-75	0	0	17	83	42	0	0	0	91	73	0	0	75	100	8
76-100	0	0	0	0	58	0	0	0	0	18	0	0	0	0	58
101-125	-	-	-	-	-	-	-	-	-	-	0	0	0	0	34
126 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	78	5	8	0	0	38	0	0	0	0	90	60	0	0	0	100	52	17	0	0	86	32	17	8	8
26-50	22	95	17	8	8	62	100	67	0	0	10	40	100	50	0	0	48	83	50	0	14	68	75	25	8
51-75	0	0	75	67	0	0	0	33	10	8	0	0	0	50	100	0	0	0	50	50	0	0	8	67	50
76-100	0	0	0	25	75	0	0	0	90	92	-	-	-	-	-	0	0	0	0	50	0	0	0	0	34
101-125	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis 'Lutea'

See colour plate

Family	:	Cupressaceae
English name	:	George Peabody arborvitae
French name	:	Thuja occidentale doré
Category	:	Evergreen plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This tree, with a narrow pyramidal or conical growth habit, can attain a height of 12 m in Europe, but approximately 6 m in Quebec.

The branches are ascending and the branchlets of the year are often vertical.

The golden foliage only turns green in the spring of the second year. The side receiving the most sunlight is golden and the other side is yellowish-green.

The bark is reddish-brown and contrasts strongly with the foliage.

ORIGIN AND DISTRIBUTION

This cultivar was known before 1873.

USE

Ornamental: This tree is used standing alone or in clumps.

REQUIREMENTS

The young branchlets grow in all directions during the initial years, but a leader eventually forms.

To maintain the golden colour of its foliage and its regular growth habit, a sunny exposure is preferable.

Like the type species, this cultivar prefers moist soils.

PATHOLOGY

To our knowledge, this cultivar is not particularly affected by any disease. The thuja bark beetle (*Phloeosinus* sp.) can cause withering and yellowing of the branches of the species and its cultivars.

PROPAGATION

Propagation by cuttings: Heel cuttings, taken from the year's wood, take root very well if they are taken between November and March.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Agriculture Canada Experimental Farm, L'Assomption, Quebec

Propagation technique: Cuttings of 15 cm were taken on December 19, 1983 and treated with a solution of 10,000 ppm IBA. They were placed in a substrate composed of peat and perlite, then placed in a greenhouse under mist for a duration of 15 seconds every 15 minutes. The rooting rate was 61%. In May and June 1984, the rooted cuttings were potted in the same type of substrate and placed in an outside frame on July 3, 1984. In May 1985, the plants were wrapped and placed in a cold store until they were shipped a few days later.

Inclusion in test network: Young plants 12 to 15 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality was very low and occurred particularly following the first winter. Browning of the foliage was the most serious damage and was observed at three test sites following different winters.

Region 1

No damage occurred at L'Assomption on clay or at Sainte-Clotilde.

***Thuja occidentalis* 'Lutea'**

At Sainte-Anne-de-Bellevue, 95% or more of the plants did not suffer any damage four years out of five. At this site, 83% of the plants exhibited frost damage on the stem tips following the fourth winter.

At L'Assomption on sand, 60% of the plants exhibited browning of the foliage following the last winter.

Region 2

At Sainte-Foy, no damage was observed following the first two winters and the last winter, while 33% and 25% of the plants exhibited frost damage on the stem tips the other two winters.

At Deschambault, the plant that died following the first winter had exhibited no growth during the first growing season. Some 25% of the plants suffered mechanical breakage the last winter and 17% suffered frost damage on the stem tips following the fourth winter.

Following the second winter, the only damage observed at La Pocatière was browning of the foliage on 30% of the plants.

Region 3

This cultivar was not affected at Normandin. During the five years, only 33% of the plants exhibited frost damage on the stem tips the fourth winter.

At Kapuskasing, 67% to 95% of the plants did not suffer any damage during the testing period. Three plants died following the first winter and another the fourth winter. In addition, 25% and 10% of the plants exhibited browning of the foliage following the third and last winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 0.81 m R2 = 0.77 m R3 = 0.49 m

Categories

The average height of the trees after five years varied from one site to another:

0.91 - 1.00 m: Sainte-Anne-de-Bellevue and Sainte-Clotilde
 0.81 - 0.90 m: Sainte-Foy
 0.71 - 0.80 m: Deschambault
 0.61 - 0.70 m: L'Assomption on clay, L'Assomption on sand and La Pocatière
 0.51 - 0.60 m: Kapuskasing
 0.50 m and - : Normandin

By the second year, the plants at the Sainte-Anne-de-Bellevue, Sainte-Clotilde and Sainte-Foy sites were taller than those at all or almost all of the other sites.

At Normandin, three plants exhibited no growth during the last four years without, however, showing signs of frost damage.

Effect of pruning

Pruning was very minor.

Growth in width

After five years, the average width of the trees for each region was:

R1 = 0.67 m R2 = 0.57 m R3 = 0.30 m

The L'Assomption site on clay was excluded from the regional average for region 1.

The plants in region 3 were less wide than those at the other sites.

Categories

The average width of the trees after five years varied from one site to another:

0.71 - 0.80 m: Sainte-Clotilde
 0.61 - 0.70 m: Sainte-Anne-de-Bellevue and Sainte-Foy
 0.51 - 0.60 m: L'Assomption on sand and La Pocatière
 0.41 - 0.50 m: Deschambault
 0.31 - 0.40 m: L'Assomption on clay
 0.30 cm and - : Kapuskasing and Normandin

The plants doubled in width. This difference was very pronounced from the third growing season and the sites classified in each category were clearly different from each other.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This cultivar is very slow-growing since, at the sites with the warmest climatic conditions, the trees were only just over 1 m high after five years.

After two years, 57% of the trees at Sainte-Anne-de-Bellevue were 41 to 60 cm high. A third year of production allowed 75% to 92% of the trees at the Sainte-Anne-de-Bellevue, Sainte-Clotilde, Sainte-Foy and Deschambault sites to reach a height of between 41 and 60 cm.

A fourth year was necessary at the two L'Assomption sites and a fifth year at Kapuskasing to obtain trees of comparable height.

Production was much faster in the region south of Montreal, but this cultivar is not competitive in conditions similar to those of region 3.

Use

A zone rating of 2a would be too restrictive for this cultivar. However, despite the tolerance of these plants to the climatic conditions of this region, growth there was almost nil and they behave like dwarf plants.

As was the case for the 'Fastigiata' and 'Woodwardii' cultivars, damage from browning of the foliage occurred at three of the sites and this cultivar should be protected from winds and sunscald during the winter.

BIBLIOGRAPHICAL REFERENCES

3, 13, 14, 27, 44, 49, 60, 68, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Lutea' from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	100										0
L'Assomption-sand	87	1								12	13
Ste-Anne-de-Bellevue	82	18									18
Sainte-Clotilde	100										0
REGION 2											
Deschambault	91	3				1		5			9
Sainte-Foy	89	11									11
La Pocatière	92									8	8
REGION 3											
Normandin	93	7									7
Kapuskasing	88					5				7	12

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents
 14 = partial browning of the foliage

No damage of types 3, 4, 5, 6, 7, 9 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Lutea' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-20	75	5	0	0	0	76	43	0	0	0	90	0	0	0	0	71	5	0	0	0					
21-40	25	95	67	0	0	24	57	83	8	0	10	67	17	0	0	29	38	8	0	0					
41-60	0	0	33	67	8	0	0	17	75	33	0	33	75	25	0	0	57	50	8	0					
61-80	0	0	0	33	83	0	0	0	17	50	0	0	8	75	25	0	0	42	83	17					
81-100	0	0	0	0	9	0	0	0	0	17	0	0	0	0	58	0	0	0	9	42					
101-120	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17	0	0	0	0	41					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	57	0	0	0	0	76	20	0	0	0	90	9	0	0	0	48	33	33	17	8	70	71	45	10	10
21-40	43	60	0	0	0	24	70	25	0	0	10	86	58	0	0	52	67	67	66	58	30	29	55	60	0
41-60	0	40	42	17	0	0	10	75	25	17	0	5	42	50	33	0	0	0	17	17	0	0	0	30	70
61-80	0	0	58	58	33	0	0	0	67	66	0	0	0	33	50	0	0	0	0	17	0	0	0	0	20
81-100	0	0	0	25	67	0	0	0	8	17	0	0	0	17	17	-	-	-	-	-	-	-	-	-	-
101-120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Lutea' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	95	70	0	0	0	95	90	42	8	0	100	29	8	0	0	100	24	8	0	0
21-40	5	30	100	75	0	5	10	58	92	75	0	71	57	33	8	0	76	67	8	8
41-60	0	0	0	25	58	0	0	0	0	25	0	0	25	67	0	0	0	25	76	17
61-80	0	0	0	0	42	-	-	-	-	-	0	0	0	0	75	0	0	0	16	75
81-100	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	95	10	0	0	0	86	65	33	8	0	100	80	8	0	0	95	47	42	50	33	100	95	64	40	10
21-40	5	90	100	42	0	14	35	50	58	42	0	20	92	25	0	5	53	58	50	67	0	5	36	60	70
41-60	0	0	0	58	17	0	0	17	34	58	0	0	0	67	83	-	-	-	-	-	0	0	0	0	20
61-80	0	0	0	0	75	-	-	-	-	-	0	0	0	8	17	-	-	-	-	-	-	-	-	-	-
81-100	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis 'Pulcherrima'

See colour plate

Family	:	Cupressaceae
English name	:	Golden American arborvitae
French name	:	Thuya occidental doré
Category	:	Evergreen plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree with a conical growth habit becomes wider at the base with age and can attain a height of 20 m in the United States. The branches are golden yellow all year round.

The specimens at the Montreal Botanical Garden are 3 m high and 2 m wide at the base after 57 years of growth.

ORIGIN AND DISTRIBUTION

This cultivar does not seem to be available on the market. It was planted at the Montreal Botanical Garden in 1937 and reportedly comes from the Orland White Arboretum, in Boyce, Virginia.

USE

Ornamental: This cultivar can be used standing alone or in clumps.

REQUIREMENTS

This tree adapts to several soil types but prefers limestone subsoils. This is a very slow-growing cultivar. Regeneration of growth after transplanting is difficult when the young plants are grown from cuttings.

PATHOLOGY

To our knowledge, no disease appears to affect this cultivar.

PROPAGATION

Propagation by cuttings: Heel cuttings, taken in late fall, take root relatively well with hormone treatment.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 416 cuttings of 10 to 15 cm were taken on December 3, 1985 and dipped for five seconds in a solution of 10,000 ppm IBA and 50% ethanol. They were placed in a greenhouse under mist for a duration of 30 seconds every hour. They were transferred to a substrate composed of peat (40%) and perlite (60%). The rooting rate was 64% after eight weeks and 76% after 10 weeks. The rooted plants were potted in Fertil Pots® on February 13 and March 4, 1986. They were kept in a greenhouse until April 8. They were wrapped and placed in a cold store at 4°C until they were shipped a few days later.

Inclusion in test network: Young plants 10 to 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

After transplanting, losses of approximately 10% to 20% were observed at every site, except Kapuskasing, where losses were approximately 50%. No plants survived the testing at Kapuskasing, while only three plants survived at Normandin. Frost damage was clearly more severe in region 2 than in region 1.

Region 1

At L'Assomption on sand, two plants died during the first two winters and no other damage affected the plants subsequently.

At the L'Assomption site on clay, no frost damage occurred during testing, but 25% of the plants died the fourth winter.

No damage occurred at Sainte-Clotilde.

Region 2

At the Sainte-Foy site, damage from desiccation of the foliage was observed on 27% and 72% of the plants during the first two winters respectively. In addition, 7%, 7% and 9% of the plants died during the first three winters. No other damage occurred subsequently.

At Deschambault, mortality was high, particularly during the second and third winters, resulting in the death of 33% and 36% of the plants respectively. As well, 46% and 71% of the plants suffered browning of the foliage the third and fourth winters.

At La Pocatière, mortality was approximately 30% and 17% during the first two winters. In addition, between 42% and 100% of the plants were affected by browning of the foliage the first four winters.

Region 3

At Normandin, 67% and 50% of the plants died during the first two winters, leaving only three plants under evaluation. The latter exhibited frost damage on the stem tips during the initial years and subsequently no other damage was evident.

At Kapuskasing, all the plants in the test died after the first few winters.

Growth in height

After five years, the average height of the trees for each region was:

R1 = 0.93 m R2 = 0.45 m R3 = *

* Too few plants survived to establish a representative average.

Categories

The average height of the trees after five years varied from one station to another:

1.01 - 1.25 m: Sainte-Clotilde and L'Assomption on sand

0.51 - 1.00 m: Sainte-Foy and L'Assomption on clay

0.50 m and - : Deschambault and La Pocatière

Effect of pruning

Pruning was necessary only to remove the damaged foliage.

Growth in width

After five years, the average width for each region was:

R1 = 0.48 m R2 = 0.43 m R3 = *

The plants were as wide as they were high in region 2, while they were twice as high as wide in region 1.

* Too few plants survived the testing to establish a representative average.

Categories

The average width of the trees after five years varied from one station to another:

0.51 - 0.75 m: Sainte-Foy, Sainte-Clotilde and L'Assomption on sand

0.26 - 0.50 m: Deschambault, L'Assomption on clay and La Pocatière

RECOMMENDATIONS

Table 2 indicates the percentage of marketable plants by category at each test site for the final height obtained after each year. Nursery growers will find this table useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height.

Production

The young plants, at the rooted cutting stage, became established with difficulty during testing; this same phenomenon was observed with several other cultivars with golden foliage. It is possible that establishment might be easier with young plants two or three years old grown in containers. The growth of the plants was faster and damage much less frequent in region 1.

***Thuja occidentalis* 'Pulcherrima'**

It is possible to produce this cultivar in region 2, but damage from browning of the foliage reduced the esthetic and ornamental appearance of the young plants.

Use

The zone rating of this cultivar was unknown. The test results enable us to evaluate its potential only at a young age. It can be assigned a rating of 4b or 5a.

BIBLIOGRAPHICAL REFERENCES

NIL

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Pulcherrima' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	95					5					5
L'Assomption-sand	98					2					2
Sainte-Clotilde	100										0
REGION 2											
Deschambault	59					18				23	41
Sainte-Foy	75					5				20	25
La Pocatière	25					9				66	75
REGION 3											
Normandin	8	7				85					92
Kapuskasing	0					100					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 splitting |
| 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 types 3, 4, 5, 6, 7, 9, 10 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Pulcherrima' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	73	45	0	0	100	70	92	17	10	100	56	8	0	0
21-40	0	27	55	36	0	0	30	8	75	90	0	44	92	27	0
41-60	0	0	0	64	100	0	0	0	8	0	0	0	0	73	27
61-80	-	-	-	-	-	-	-	-	-	-	0	0	0	0	73
81 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	64	27	0	0	94	80	50	50	10	100	100	63	57	33	-	-	-	-	-	-	-	-	-	-
21-40	0	36	73	20	10	6	20	50	50	40	0	0	37	43	67	-	-	-	-	-	-	-	-	-	-
41-60	0	0	0	70	20	0	0	0	0	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61-80	0	0	0	10	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81 and +	0	0	0	0	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis 'Reidii'

See colour plate

Family	:	Cupressaceae
English name	:	Reid American arborvitae
French name	:	Thuya occidentale 'Reidii'
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub, with a wide, conical growth habit, can attain a height of 4 m and a width of 2.5 m.

The foliage is dense, dark green and finely serrate. In the fall, the new shoots turn golden brown after the first frosts. Subsequently, the foliage becomes brownish.

ORIGIN AND DISTRIBUTION

This cultivar was introduced in 1939 to the collections of the Montreal Botanical Garden and comes from Coscob in Connecticut.

USE

Ornamental: This shrub is mainly used standing alone or in clumps.

REQUIREMENTS

No information is available.

PATHOLOGY

No information is available.

PROPAGATION

Propagation by cuttings: The cultivars are propagated 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: 300 cuttings of 20 cm were taken on November 28, 1984 from 40-year-old parent plants. They were treated with a solution of 4,000 ppm IBA and placed in a substrate composed of sand, peat and perlite (2:1:1), then placed under mist at a frequency of six seconds every nine minutes. The heating cables were set to 22°C. Rooting was observed beginning in February 1985 and the cuttings were potted in March. They were kept in a greenhouse until they were shipped in May.

Inclusion in test network: Young plants 15 to 18 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

This cultivar exhibited very little damage during testing. A few plants occasionally suffered frost damage on the stem tips, mechanical breakage or browning of the foliage. Only two plants died at Kapuskasing.

Region 1

No damage was observed at Sainte-Clotilde.

At L'Assomption on sand and on clay, minor damage was observed following the fourth winter only: the plants in replications 2 and 3 suffered frost damage on the stem tips.

At Sainte-Anne-de-Bellevue, one plant suffered frost damage on the stem tips following the first and fourth winters.

Region 2

At Sainte-Foy and at La Pocatière, only two plants suffered browning of the foliage following the second winter.

At Deschambault, no winter frost damage was observed. However, the fourth winter, one plant suffered mechanical breakage and, the fifth winter, all the plants were also affected by this type of damage.

Region 3

At Normandin, more than 80% of the plants suffered no damage during the testing period; only one plant suffered frost damage on the stem tips following the third winter and two plants were affected by mechanical breakage the last winter.

At Kapuskasing, the two plants that died following the first two winters had exhibited no growth the previous year. As well, 25% of the plants suffered mild frost damage following the second winter and a few plants were affected by cold or snow the last two winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.81 m R2 = 0.84 m R3 = 0.72 m

Once the plant was established, annual growth was generally regular and ranged from 15 to 20 cm annually; however, at La Pocatière it was significant one year out of two and, at Normandin, it was irregular.

The plants in region 2 were slightly taller than those in region 1, particularly because of the significant height attained by the plants at Sainte-Foy.

Categories

The average height of the shrubs after five years varied from one site to another:

- 0.91 - 1.00 m: Sainte-Foy
- 0.81 - 0.90 m: Sainte-Clotilde, Sainte-Anne-de-Bellevue, Deschambault, L'Assomption on sand and Normandin
- 0.71 - 0.80 m: La Pocatière
- 0.61 - 0.70 m: L'Assomption on clay and Kapuskasing

The final height of the plants was lower at sites with clay soil.

Effect of pruning

Very little pruning was necessary on this cultivar.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.77 m R2 = 0.83 m R3 = 0.67 m

The plants in region 2 were slightly wider than those in region 1, particularly because of the significant width attained by the plants at Sainte-Foy.

Categories

The average width of the shrubs after five years varied from one site to another:

- 0.91 m and + : Sainte-Foy
- 0.81 - 0.90 m: Sainte-Clotilde and Sainte-Anne-de-Bellevue
- 0.71 - 0.80 m: Deschambault, L'Assomption on sand and La Pocatière
- 0.61 - 0.70 m: Normandin and Kapuskasing
- 0.51 - 0.60 m: L'Assomption on clay

Annual growth in width was heterogeneous among specimens at the same site. By the third year, the width attained by the plants was a very good indicator of their future annual growth.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height and width.

Production

After three years of growth, the growth of the shrubs was very similar at the sites in regions 1 and 2. However, the Sainte-Foy site produced the largest plants and it was the only site where 42% of the plants attained a height of 61 to 80 cm during this period.

It took a fourth year of growth at the other sites to obtain comparable plants.

This cultivar grows more slowly on heavy soils.

Thuja occidentalis* 'Reidii'*Use**

Based on our results, this cultivar is quite hardy at all the test sites and can be assigned a zone rating of 2a without risk. However, although this cultivar is very hardy, it currently exists only in the collection of the Montreal Botanical Garden.

Heavy soils considerably slow the growth of this cultivar.

BIBLIOGRAPHICAL REFERENCES

3, 60

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Reidii' from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	97	3									3
L'Assomption-sand	87	13									13
Ste-Anne-de-Bellevue	98	2									2
Sainte-Clotilde	100										0
REGION 2											
Deschambault	73							27			27
Sainte-Foy	98									2	2
La Pocatière	98									2	2
REGION 3											
Normandin	95	2								3	5
Kapuskasing	86	5				2	2	5			14

- ^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 splitting |
| 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 types 3, 4, 6, 7 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Reidii' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	67	0	0	0	0	67	0	0	0	0	95	0	0	0	0	43	0	0	0	0
21-40	33	81	25	0	0	33	100	25	0	0	5	71	0	0	0	57	48	0	0	0
41-60	0	19	75	8	0	0	0	75	75	33	0	29	100	0	0	0	52	83	0	0
61-80	0	0	0	92	25	0	0	0	25	67	0	0	0	100	0	0	0	17	92	17
81-100	0	0	0	0	75	-	-	-	-	-	0	0	0	0	100	0	0	0	8	83
101 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	55	5	0	0	0	29	19	0	0	0	86	0	0	0	0	81	0	0	0	0	65	53	9	0	0
21-40	45	45	0	0	0	71	76	8	0	0	14	90	33	0	0	19	90	58	0	0	35	47	73	27	9
41-60	0	50	58	0	0	0	5	84	8	0	0	10	67	25	0	0	10	42	75	0	0	0	18	64	36
61-80	0	0	42	75	17	0	0	8	75	25	0	0	0	75	92	0	0	0	25	58	0	0	0	9	45
81-100	0	0	0	25	50	0	0	0	17	75	0	0	0	0	8	0	0	0	0	42	0	0	0	0	10
101 and +	0	0	0	0	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Reidii' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	76	0	0	0	0	95	57	0	0	0	67	0	0	0	0	90	0	0	0	0
21-40	24	100	67	0	0	5	43	92	8	0	33	100	0	0	0	10	95	0	0	0
41-60	0	0	33	33	17	0	0	8	92	75	0	0	92	0	0	0	5	100	0	0
61-80	0	0	0	67	42	0	0	0	0	25	0	0	8	100	25	0	0	0	100	33
81-100	0	0	0	0	41	-	-	-	-	-	0	0	0	0	75	0	0	0	0	67
101 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	24	0	0	0	0	14	5	0	0	0	81	5	0	0	0	86	0	0	0	0	95	16	0	0	0
21-40	71	40	0	0	0	86	90	8	0	0	19	90	42	0	0	14	67	67	0	0	5	84	64	18	0
41-60	5	60	75	0	0	0	5	75	25	0	0	5	58	25	0	0	33	33	75	17	0	0	36	82	9
61-80	0	0	25	83	8	0	0	17	67	67	0	0	0	75	83	0	0	0	25	83	0	0	0	0	73
81-100	0	0	0	17	58	0	0	0	8	33	0	0	0	0	17	-	-	-	-	-	0	0	0	0	18
101 and +	0	0	0	0	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis 'Smaragd'

See colour plate

Family	:	Cupressaceae
English name	:	Smaragd American arborvitae
French name	:	Thuya émeraude
Category	:	Evergreen plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub, with a narrow and very regular conical growth habit, can attain a height of 5 m in the United States.

The foliage is fine and glossy light green in colour year-round. The branchlets are vertical and enhance the decorative interest of this cultivar.

ORIGIN AND DISTRIBUTION

This cultivar is originally from Denmark and was developed around 1950 by D.T. Poulsen.

USE

Ornamental: This cultivar is mainly used standing alone for its regular growth habit, but it can also be placed in clumps or hedges.

REQUIREMENTS

Like all *Thuja*, it prefers a sunny exposure for better growth and development. However, this exposure increases its vulnerability to browning of the foliage, which occurs during the winter.

Therefore, its foliage should be protected from direct sunlight during this season.

PATHOLOGY

No particular disease appears to affect this cultivar.

PROPAGATION

Propagation by cuttings: Heel cuttings, taken in late fall, take root very well with hormone treatment.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Agriculture and Agri-Food Canada research Farm, L'Assomption, Quebec

Propagation technique: 427 cuttings of 15 cm were taken on December 4, 1985 and dipped for five seconds in a solution of 5,000 ppm IBA and 50% ethanol. They were transferred to a substrate composed of peat (40%) and perlite (60%) and placed in a greenhouse under mist for a duration of 30 seconds every hour. The rooting rate was 85% after 10 weeks. The rooted plants were potted in Fertil Pots® in mid-February and in March. They were kept in a greenhouse until April 8. They were wrapped and placed in a cold store at 4°C until they were shipped a few days later.

Inclusion in test network: Young plants 10 to 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

The main damage observed was desiccation of the foliage at the sites in region 2. Mortality was higher in region 3.

Region 1

No damage occurred at the Sainte-Clotilde and L'Assomption on sand sites as well as during the first, third and fifth winters at the L'Assomption site on clay. At the latter site, 33% of the plants were gnawed by field mice the second winter and 17% of the plants suffered partial desiccation of the foliage the fourth winter.

Region 2

At Sainte-Foy, no damage occurred during the first two winters and the fourth winter. The third winter, 25% of the plants suffered frost damage on the stem tips and, the last winter, 40% of the plants suffered browning of the foliage.

At Deschambault, damage occurred during the last two winters: four plants died and all the living plants suffered desiccation of the foliage the last winter.

At La Pocatière, as at the other two sites in this region, the main damage was desiccation of the foliage affecting 60%, 33% and 76% of the plants the first, third and fourth winters respectively. One plant died during the first winter.

Region 3

At Normandin, no damage occurred during the first four years. The last winter, 17% of the plants died and 17% of the plants suffered frost damage on the stem tips.

At Kapuskasing, mortality was approximately 10% to 22% four years out of five. In addition, 65% of the plants suffered frost damage on the stem tips the first winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.11 m R2 = 0.97 m R3 = 0.69 m

The height of the plants was comparable among the sites in regions 1 and 2.

Categories

The average height of the shrubs after five years varied from one station to another:

1.26 m and + : L'Assomption on sand
 1.01 - 1.25 m: Deschambault, Sainte-Foy and Sainte-Clotilde
 0.76 - 1.00 m: L'Assomption on clay and Normandin
 0.51 - 0.75 m: La Pocatière and Kapuskasing

Growth was clearly lower at the sites with clay soil, for both the height and width of the plants.

Effect of pruning

No pruning for shaping was necessary for these plants.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.46 m R2 = 0.47 m R3 = 0.38 m

The sites in regions 1 and 2 produced shrubs of similar width.

Categories

The average width of the shrubs after five years varied from one station to another:

0.51 m and + : Sainte-Foy
 0.41 - 0.50 m: L'Assomption on sand, Sainte-Clotilde, Deschambault and Normandin
 0.31 - 0.40 m: L'Assomption on clay, La Pocatière and Kapuskasing

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This cultivar has very satisfactory growth on lighter soils. After three years of growth, 100% of the plants at the L'Assomption on sand, Sainte-Clotilde, Deschambault and Sainte-Foy sites had attained a height of more than 50 cm, while 58% of the plants at L'Assomption on clay were of comparable height.

At Normandin, four years were necessary to obtain a comparable height and a fifth year was required at the other two sites.

***Thuja occidentalis* 'Smaragd' ...**

This cultivar grows fairly quickly during the year following planting. On clay soils, it is necessary to wait a second year before significant growth is observed.

Use

This cultivar suffered no damage in zones 5a and 5b. Although survival of the plants was good in zone 2b, the slower growth and diminished ornamental character of this cultivar tend to limit its use to zone 4, provided that the plants are adequately protected against winter desiccation of the foliage.

BIBLIOGRAPHICAL REFERENCES

4, 14, 56

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Smaragd' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	90								7	3	10
L'Assomption-sand	100										0
Sainte-Clotilde	100										0
REGION 2											
Deschambault	71					9		2		18	29
Sainte-Foy	87	5								8	13
La Pocatière	67					1				32	33
REGION 3											
Normandin	94	3				3					6
Kapuskasing	75	13				12					25

- ^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 splitting |
| 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 types 3, 4, 5, 6, 7 and 9 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Smaragd' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	0	0	0	0	95	0	0	0	0	90	0	0	0	0
26-50	0	100	0	0	0	5	100	42	0	0	10	67	0	0	0
51-75	0	0	42	0	0	0	0	58	100	0	0	33	75	17	0
76-100	0	0	58	58	0	0	0	0	0	83	0	0	25	75	33
101-125	0	0	0	42	25	0	0	0	0	17	0	0	0	8	67
126-150	0	0	0	0	58	-	-	-	-	-	-	-	-	-	-
151 and +	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-

Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-25	100	0	0	0	0	100	5	0	0	0	100	74	17	0	0	100	90	0	0	0	100	100	22	0	0
26-50	0	85	0	0	0	0	95	0	0	0	0	26	67	83	0	0	10	92	8	8	0	0	78	89	22
51-75	0	15	67	0	0	0	0	100	0	0	0	0	16	17	75	0	0	8	58	17	0	0	0	11	78
76-100	0	0	33	67	50	0	0	0	67	33	0	0	0	0	25	0	0	0	34	58	-	-	-	-	-
101-125	0	0	0	33	33	0	0	0	33	58	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-
126-150	0	0	0	0	17	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Smaragd' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	19	0	0	0	100	52	17	0	0	100	10	0	0	0
21-40	0	81	100	8	0	0	48	83	50	75	0	90	100	25	8
41-60	0	0	0	67	100	0	0	0	50	25	0	0	0	75	92
61 and +	0	0	0	25	0	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-20	100	5	0	0	0	100	68	0	0	0	100	85	33	0	0	100	100	58	8	0	100	93	67	0	0
21-40	0	95	92	25	0	0	32	100	100	0	0	15	67	100	83	0	0	42	83	25	0	7	33	100	100
41-60	0	0	8	75	100	0	0	0	0	100	0	0	0	0	17	0	0	0	9	75	-	-	-	-	-
61 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis**'Wareana'**

See colour plate

Family	:	Cupressaceae
English name	:	Siberian arborvitae, Siberian cedar
French name	:	Thuya de Sibérie
Synonym	:	<i>Thuja occidentalis</i> 'Robusta'
Category	:	Evergreen plant

BOTANICAL DESCRIPTION

This shrub with a wide, conical growth habit is compact and can attain a height of 3 m in Quebec and 7 m in Europe. The crown is rounded on mature specimens.

The branches are ascending. The foliage is coarse and dense and the branchlets are thicker than those of the type species. The foliage is bluish-green on young specimens, becoming dark green as they get older. The fall colours are purplish.

ORIGIN AND DISTRIBUTION

This cultivar was developed in Great Britain around 1827.

USE

Ornamental: This cultivar can be used in clumps, standing alone, as a free hedge or as a pruned hedge at least 1.5 m high.

REQUIREMENTS

It stands up well to winds and does very well on the Canadian Prairies.

It is slow-growing.

Like the type species, this cultivar prefers moist soils and sunny exposures.

PATHOLOGY

To our knowledge, no particular disease affects this cultivar. The thuja bark beetle (*Phloeosinus* sp.) can cause withering and yellowing of the branches of the species and its cultivars.

PROPAGATION

Propagation by cuttings: Heel cuttings, taken from the year's shoot between November and March, take root very well.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: 300 cuttings of 20 cm were taken on November 28, 1984 from 25-year-old parent plants 2.5 m high. They were treated with a solution of 4,000 ppm IBA and placed in a substrate composed of sand, peat and perlite (2:1:1), then placed in a greenhouse under mist at a frequency of six seconds every nine minutes. The rooting rate was 90% in February 1985. The cuttings were potted in March. They were kept in a cold greenhouse until they were shipped in May.

Inclusion in test network: Young plants 15 to 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)**Winter damage**

Damage was very minor or nil at seven of the nine stations.

Region 1

For the four sites in this region, damage was nil or was observed on only one plant and on only one occasion at the beginning of testing.

Region 2

At Sainte-Foy, only one plant exhibited frost damage on the stem tips at the end of the second winter.

At Deschambault, only one plant died following the first winter and 30% of the plants suffered mechanical breakage the last winter.

At La Pocatière, 50% to 60% of the plants suffered browning of the foliage following the second and fourth winters. No other damage was observed on the plants.

Region 3

At Normandin, as in region 1, only one plant exhibited frost damage on the previous year's shoot following the third winter.

Several types of damages occurred at Kapuskasing. However, 48% to 100% of the plants did not suffer any damage over the years. Only one plant died during the second winter and two others the following winter. As well, 50% of the plants were affected by frost damage on the tips of the shoots the second winter.

A few plants occasionally suffered browning of the foliage, trunk splitting or sunscald.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.87 m R2 = 0.79 m R3 = 0.69 m

The sites on clay soils brought down their respective regional averages.

Categories

The average height of the shrubs after five years varied from one site to another:

- 0.91 - 1.00 m: Sainte-Foy, Sainte-Anne-de-Bellevue and Sainte-Clotilde
- 0.81 - 0.90 m: L'Assomption on sand
- 0.71 - 0.80 m: Normandin, L'Assomption on clay and La Pocatière
- 0.61 - 0.70 m: Deschambault and Kapuskasing

From the third year, the height of the plants at Sainte-Foy, Sainte-Anne-de-Bellevue and Sainte-Clotilde was clearly greater than that of the plants at the other sites.

Effect of pruning

Very little pruning was necessary on this cultivar.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.68 m R2 = 0.67 m R3 = 0.57 m

Although the plants in region 1 were taller than those in region 2, there was no difference in their width.

The plants at Sainte-Foy were significantly wider than those at the other sites by the end of the first year.

Categories

The average width of the shrubs after five years varied from one site to another:

- 0.71 - 0.80 m: Sainte-Foy, Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand
- 0.61 - 0.70 m: La Pocatière and Kapuskasing
- 0.51 - 0.60 m: Normandin, Deschambault and L'Assomption on clay

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After three years of growth, between 92% and 100% of the plants at the Sainte-Clotilde, Sainte-Anne-de-Bellevue and Sainte-Foy sites as well as 75% and 83% of the plants at the L'Assomption sites had attained a height of 40 to 61 cm. This percentage fell to 50% for the La Pocatière and Normandin sites and to 34% for Deschambault. It would therefore take a fourth year of growth at these sites to produce shrubs of comparable height.

***Thuja occidentalis* 'Wareana'**

Based on the results obtained, we are unable to determine the reasons for the poor growth at Deschambault. The pedological conditions seem to have a significant impact on growth, although after three or four years, the plants at the L'Assomption on clay site had attained the same size as those at L'Assomption on sand.

Use

Based on our results, this cultivar is quite hardy at all the test sites and can be assigned a zone rating of 2a.

The Kapuskasing site evidently represents the true limit for use of this cultivar, since a certain number of plants were affected the last two winters. Damage, although not too severe, modified the growth habit and appearance of the plants.

Heavy soils considerably slow the growth of this cultivar.

BIBLIOGRAPHICAL REFERENCES

3, 13, 14, 27, 47, 50, 56, 60, 68, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Wareana' from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	100										0
L'Assomption-sand	99					1					1
Ste-Anne-de-Bellevue	99	1									1
Sainte-Clotilde	99		1								1
REGION 2											
Deschambault	91					1		8			9
Sainte-Foy	99	1									1
La Pocatière	77						1			22	23
REGION 3											
Normandin	98		2								2
Kapuskasing	70	10				5	9	4		2	30

- ^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 splitting |
| 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 types 3, 6, 7 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Wareana' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-20	76	5	0	0	0	67	14	0	0	0	81	0	0	0	0	40	0	0	0	0					
21-40	24	65	25	0	0	33	86	17	0	0	19	38	0	0	0	60	60	8	0	0					
41-60	0	30	75	33	25	0	0	83	33	0	0	62	75	0	0	0	40	50	8	0					
61-80	0	0	0	58	8	0	0	0	67	100	0	0	17	75	0	0	0	42	67	8					
81-100	0	0	0	9	59	-	-	-	-	-	0	0	8	25	92	0	0	0	25	50					
101-120	0	0	0	0	8	-	-	-	-	-	0	0	0	0	8	0	0	0	0	42					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	5	0	0	0	0	52	25	8	0	0	57	0	0	0	0	81	0	0	0	0	40	40	0	0	0
21-40	95	5	0	0	0	48	75	58	8	0	43	90	50	0	0	19	95	50	0	0	60	60	100	11	0
41-60	0	90	0	0	0	0	0	34	52	25	0	10	50	25	8	0	5	50	100	0	0	0	0	89	22
61-80	0	5	92	42	0	0	0	0	40	58	0	0	0	75	92	0	0	0	0	100	0	0	0	0	78
81-100	0	0	8	58	83	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101-120	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Wareana' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	86	5	0	0	0	100	67	0	0	0	90	0	0	0	0	80	0	0	0	0
21-40	14	95	67	0	0	0	33	100	75	0	10	100	33	0	0	20	95	25	0	0
41-60	0	0	33	66	17	0	0	0	25	100	0	0	67	83	0	0	5	75	59	17
61-80	0	0	0	34	58	-	-	-	-	-	0	0	0	17	100	0	0	0	41	58
81-100	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	24	0	0	0	0	43	20	8	8	0	86	0	0	0	0	95	0	0	0	0	95	15	0	0	0
21-40	76	33	0	0	0	57	80	58	25	33	14	100	42	0	0	5	90	100	33	8	5	85	78	33	0
41-60	0	67	100	75	0	0	0	34	67	33	0	0	58	58	17	0	10	0	67	83	0	0	22	67	33
61-80	0	0	0	25	58	0	0	0	0	34	0	0	0	42	75	0	0	0	0	9	0	0	0	0	67
81-100	0	0	0	0	42	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-

Thuja occidentalis 'Woodwardii'

See colour plate

Family	:	Cupressaceae
French name	:	Thuja occidental 'Woodwardii'
English name	:	Woodward American arborvitae
Category	:	Evergreen plant

BOTANICAL DESCRIPTION

This dwarf shrub can attain a height of 1 m and a slightly greater width. The shape tends to be ovoid when the plant is young, becoming globular as it gets older.

The dense foliage is light green year-round, with the exception of the fact that the tips turn brown in the winter.

When the plant is young, the branchlets grow vertically, parallel and fairly closely spaced and are the same colour on the inner surface.

The root system is shallow and spreading.

ORIGIN AND DISTRIBUTION

This cultivar was named in 1872 by J. Woodward Manning.

USE

Ornamental: This cultivar is used in borders, rock gardens or standing alone.

REQUIREMENTS

Like the type species, this cultivar prefers moist limestone soil and a sunny exposure. It requires frequent watering after planting.

PATHOLOGY

To our knowledge, this cultivar is not particularly affected by any disease. The thuja bark beetle

(*Phloeosinus* sp.) can cause withering and yellowing of the branches of *Thuja* and its cultivars.

PROPAGATION

Propagation by cuttings: Heel cuttings, taken from the year's shoot between November and March, take root very well.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

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

Propagation technique: Cuttings of 15 cm were taken on December 19, 1983 and treated with a solution of 10,000 ppm IBA. They were placed in a greenhouse in a substrate composed of peat and perlite. Mist was applied at a frequency of 15 seconds every 15 minutes. The rooting rate was 84%. In May and June 1984, the plants were potted in small pots in a substrate composed of equal parts peat and perlite. They were then placed in an outside frame on July 3. The winter survival rate was 100%. In May 1985, the plants were wrapped and placed in a cold store until they were shipped a few days later.

Inclusion in test network: Young plants 10 to 14 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

At several sites, the plants did not suffer any damage.

Region 1

At L'Assomption on clay and Sainte-Clotilde, the plants did not suffer any damage during the testing period, with the exception of one plant that died the second winter. At L'Assomption on sand, conditions during the fourth winter caused browning of the foliage on 67% of the plants, while the others exhibited frost damage on the stem tips. No damage was observed the other four winters.

At Sainte-Anne-de-Bellevue, excluding the death of one plant the second winter, no plants were affected the second, third and fifth winters; only 15% and 33% of the plants suffered frost damage on the stem tips the other two winters.

Region 2

No damage was observed at Sainte-Foy.

At Deschambault, only one plant died following the second winter and 17% of the plants suffered mechanical breakage the last winter.

At La Pocatière, the damage observed on the foliage of the plants occurred following the second and fourth winters on 22% and 33% of the plants.

Region 3

No damage was observed at Normandin.

Following the first winter, one plant died at Kapuskasing and another exhibited frost damage on the previous year's shoot. No damage was observed the last three winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.67 m R2 = 0.66 m R3 = 0.60 m

There was little difference between the regions.

Categories

The average height of the shrubs after five years varied little from one site to another:

0.71 - 0.75 m: Sainte-Foy, Sainte-Clotilde and Sainte-Anne-de-Bellevue
 0.66 - 0.70 m: Normandin and L'Assomption on sand
 0.61 - 0.65 m: La Pocatière and Deschambault
 0.56 - 0.60 m: -
 0.51 - 0.55 m: L'Assomption on clay and Kapuskasing

Specimens at the same site were quite uniform.

From the second year, Sainte-Foy was always the site with the tallest plants. By the third year, the sites in region 1 and the Sainte-Foy site in region 2 were clearly superior to the other sites.

Effect of pruning

No pruning was necessary for this cultivar.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.73 m R2 = 0.71 m R3 = 0.59 m

From the second year, the plants were wider at Sainte-Foy and Sainte-Anne-de-Bellevue; depending on the year, growth at these sites was statistically greater than at several or all of the other sites.

Categories

The average width of the shrubs after five years varied from one site to another:

0.81 - 0.85 m: Sainte-Anne-de-Bellevue and Sainte-Foy
 0.76 - 0.80 m: Sainte-Clotilde
 0.71 - 0.75 m: -
 0.66 - 0.70 m: La Pocatière and L'Assomption on sand
 0.61 - 0.65 m: -
 0.56 - 0.60 m: Normandin, Kapuskasing, L'Assomption on clay and Deschambault

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height and width.

Production

After three years of growth, 90% or more of the shrubs at Sainte-Clotilde and Sainte-Foy had attained a height of 41 to 60 cm. This percentage fell to 67% and 42% for the Sainte-Anne-de-Bellevue and L'Assomption on sand sites.

After four years of production, virtually all the shrubs in regions 1 and 2 had attained this height, while only 71% of those at Normandin and 50% of those at Kapuskasing were of comparable height.

***Thuja occidentalis* 'Woodwardii'**

These shrubs can be produced anywhere in Quebec but their growth is faster in the Montreal and Quebec City regions. Furthermore, in cultivation, this cultivar yields very homogeneous plants.

Use

This cultivar, zoned 3 by Sherk and Buckley, was very resistant to the climatic conditions at the test sites. Damage was occasional and, generally, occurred following the first two winters. A zone rating of 2a appears conservative. Since there was no test site in zone 1, we are unable to specify the northernmost limit.

However, the browning of the foliage observed at one site in region 1 and at one site in region 2 was probably related to a lack of snow, sunscald or drying winds.

BIBLIOGRAPHICAL REFERENCES

3, 13, 14, 27, 44, 49, 50, 56, 60, 86, 100

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.

Table 1: Frequency of winter damage observed on *Thuja occidentalis* 'Woodwardii' from 1985 to 1990

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	99					1					1
L'Assomption-sand	78	7						2		13	22
Ste-Anne-de-Bellevue	94	5				1					6
Sainte-Clotilde	100										0
REGION 2											
Deschambault	95					1		4			5
Sainte-Foy	100										0
La Pocatière	89									11	11
REGION 3											
Normandin	100										0
Kapuskasing	98		1			1					2

- ^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 splitting |
| 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 types 3, 5, 6, 7, 9 and 11 occurred for this species.

Table 2: Breakdown of *Thuja occidentalis* 'Woodwardii' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-20	90	19	0	0	0	90	29	0	0	0	95	0	0	0	0	86	0	0	0	0					
21-40	10	81	58	0	0	10	71	83	0	0	5	95	8	0	0	14	100	33	0	0					
41-60	0	0	42	83	8	0	0	17	100	83	0	5	92	67	0	0	0	67	92	0					
61-80	0	0	0	17	92	0	0	0	0	17	0	0	0	33	92	0	0	0	8	100					
81-100	-	-	-	-	-	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-					
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	62	0	0	0	0	86	45	0	0	0	95	10	0	0	0	100	5	0	0	0	90	60	8	0	0
21-40	38	90	0	0	0	14	55	67	17	0	5	90	100	8	0	0	95	100	25	0	10	40	83	50	8
41-60	0	10	100	33	0	0	0	33	75	50	0	0	0	92	33	0	0	0	75	8	0	0	9	50	75
61-80	0	0	0	67	83	0	0	0	8	50	0	0	0	0	67	0	0	0	0	92	0	0	0	0	17
81-100	0	0	0	0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Thuja occidentalis* 'Woodwardii' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	95	19	0	0	0	100	71	0	0	0	67	0	0	0	0	80	0	0	0	0
21-40	5	81	83	0	0	0	29	100	0	0	33	91	25	0	0	20	90	0	0	0
41-60	0	0	17	92	8	0	0	0	100	58	0	9	75	50	0	0	10	100	0	0
61-80	0	0	0	8	92	0	0	0	0	42	0	0	0	50	67	0	0	0	91	42
81-100	-	-	-	-	-	-	-	-	-	-	0	0	0	0	33	0	0	0	9	58

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	52	0	0	0	0	86	50	0	0	0	76	10	0	0	0	100	5	0	0	0	95	30	8	0	0
21-40	48	81	0	0	0	14	50	58	17	8	24	90	75	0	0	0	95	100	17	8	5	70	67	58	0
41-60	0	19	92	8	0	0	0	42	83	42	0	0	25	67	17	0	0	0	83	67	0	0	25	42	50
61-80	0	0	8	92	25	0	0	0	0	50	0	0	0	33	83	0	0	0	0	25	0	0	0	0	50
81-100	0	0	0	0	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Ulmus pumila L.

See colour plate

Family	:	Ulmaceae
English name	:	Siberian elm, Manchurian elm (mistakenly called Chinese elm)
French name	:	Orme de Sibérie
Category	:	Deciduous plant
Subdivision	:	Large tree

BOTANICAL DESCRIPTION

This tree, with a spreading growth habit and rounded crown, can attain a height of 12 to 15 m and a width of 10 to 15 m. The first branches are low and the young branches are pendent and brittle.

The branches and buds are glabrous and round.

The foliage is dense and turns yellow in the fall. The leaves are very small compared to those of other elms. They are alternate, simple, narrow and rough, 1 to 2.5 cm wide. They are elliptic to lanceolate, the base is slightly asymmetrical and the margin is coarsely toothed. The upper surface is often pubescent and the lower surface is pale green. The leaves remain on the tree until late fall.

Flowering is very early: the flowers appear before the leaves. They are generally hermaphroditic and clustered in glomerules.

Fruit production is abundant and the fruits fall in the spring, over a three-week period.

ORIGIN AND DISTRIBUTION

This species originates in Asia and is widely used in the United States and Canada.

USE

Ornamental: The Siberian elm can be used as a screen or as a pruned hedge at least 2 m high. It makes a good screen after three years but, subsequently, it must be pruned several times in the summer and its base quickly

becomes denuded. It can be planted as a street tree where soil volume is limited.

REQUIREMENTS

This species tolerates poor, dry soils, as well as air pollution, urban environments and salt spray.

It is very fast-growing. It requires frequent pruning to maintain a regular growth habit, since the wood is very brittle and susceptible to breakage by wind and ice.

It is transplanted easily.

PATHOLOGY

This species is very susceptible to canker (*Nectria cinnabarrina*), especially when it is pruned carelessly. It is resistant to Dutch elm disease and to phloem necrosis.

Several insects attack it and occasionally cause defoliation.

PROPAGATION

Seedlings: Seeding is carried out immediately after the seeds are harvested.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Intersection of Viau Street and Rosemont Boulevard, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Quebec

Propagation technique: The seeds were harvested on June 1, 1984 and sown in a frame on June 5. They germinated at the end of the same month. The seedlings were kept in the frame until they were dug up in the fall. They were heeled in until they were shipped in May 1985.

Inclusion in test network: Seedlings 20 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

In general, the damage observed on this species was light.

The fourth winter, a small percentage of plants died at all the sites, except La Pocatière.

Region 1

Damage to the tips of the branches was noted on almost all the seedlings the first winter at the two L'Assomption sites, and the third winter at Sainte-Clotilde. At Sainte-Anne-de Bellevue, this type of damage was observed every year.

At Sainte-Clotilde, damage caused by rodents was observed on all the seedlings following the second winter and, at Sainte-Anne-de-Bellevue, on 25% of the seedlings the first winter only.

Region 2

No damage was observed at Deschambault during the five years of testing.

At Sainte-Foy and La Pocatière, damage on the tip of the previous year's shoot was observed every year on 50% to 95% of the seedlings. However, at La Pocatière, several other types of damage occurred, but in limited quantity.

Region 3

At Normandin, more than one-third of the seedlings evaluated died the fourth winter.

Damage on the stem tips was observed four years out of five at Normandin and Kapuskasing. In addition, at the latter site, fairly severe damage occurred the first and last winters, on 62% and 75% of the seedlings respectively.

Growth in height

After five years, the average height for each region was:

R1 = 4.15 m R2 = 3.08 m R3 = 2.56 m

Categories

The average height of the trees after five years varied significantly from one site to another:

4.01 - 5.00 m: Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand
 3.01 - 4.00 m: La Pocatière, L'Assomption on clay, Sainte-Foy and Normandin
 2.01 - 3.00 m: Deschambault
 2.00 m and -: Kapuskasing

The lower height of the trees at Kapuskasing brought down the regional average.

The trees at Deschambault exhibited very slow growth, although they were not affected by winter damage.

During the initial years, the growth in height of the trees at Normandin and Sainte-Foy was very significant.

Effect of pruning

Extensive pruning was carried out, mainly because of breakage caused by the wind or by deterioration of the seedlings the fourth and fifth years. This pruning was extensive at Normandin.

Growth in trunk diameter

After five years, the average trunk diameter for each region was:

R1 = 76.9 mm R2 = 60.7 mm R3 = 53.2 mm

Categories

The average trunk diameter of the trees after five years varied from one site to another:

71-80 mm: L'Assomption on sand, Sainte-Clotilde, Sainte-Anne-de-Bellevue and L'Assomption on clay
 61-70 mm: Sainte-Foy and La Pocatière
 51-60 mm: Deschambault, Normandin and Kapuskasing

Effect of pruning

Seedlings were cut back to the ground in cases of withering or breakage due to wind.

Ulmus pumila L.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants by category at each test site, for the final height and trunk diameter obtained after each year. Nursery growers will find these tables useful for estimating the annual production as well as the number of years necessary to obtain a predetermined height or diameter.

Production

After three years of growth, 40% to 60% of the trees in the test had a trunk diameter of between 40 and 60 mm at all the sites in region 1. It took a fourth year for the sites in the other regions to produce trees of comparable diameter.

The seedlings exhibited great heterogeneity, particularly from the fourth year. Height is therefore a somewhat less accurate parameter. After three years of growth, 33% of the trees at Sainte-Clotilde, Sainte-Anne-de-Bellevue and Sainte-Foy had attained a height of 2.50 m or more.

Based on the results, this species could be produced more competitively in region 1 than elsewhere, but it could be produced as far north as the Quebec City region. Choice of seeds is an important factor, and the heterogeneity observed within a group of seedlings would make it necessary to eliminate specimens that are too weak.

Use

The results obtained demonstrate that the zone rating of 3b previously assigned by Buckley is slightly underestimated and that a zone rating of 2b would be more consistent with the potential of this species, since it suffered little serious damage in this zone. More frequent and more severe damage occurred at the site in zone 2a, limiting the final height of the seedlings, but without causing further mortality.

BIBLIOGRAPHICAL REFERENCES

3, 13, 21, 51, 56, 60, 86

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.
Marie-Fleurette Beaudoin, Biol.

Table 1: Frequency of winter damage observed on *Ulmus pumila* from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	78	20				2				22	
L'Assomption-sand	75	23				2				25	
Ste-Anne-de-Bellevue	6	87			2				5	94	
Sainte-Clotilde	58	20				2			20	42	
REGION 2											
Deschambault	98							2		2	
Sainte-Foy	19	80	1							81	
La Pocatière	3	72	5	7		6	7			97	
REGION 3											
Normandin	43	40				7		10		57	
Kapuskasing	8	55	12	17		2	4	2		92	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of type 3 occurred for this species.

Table 2: Breakdown of *Ulmus pumila* plants by marketable trunk diameter category from 1985 to 1989

Trunk diameter (mm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	52	0	0	0	0	43	0	0	0	0	10	0	0	0	0	5	0	0	0	0					
11-20	43	24	0	0	0	43	14	0	0	0	90	14	0	0	0	90	10	0	0	0					
21-30	5	43	9	0	0	14	67	8	0	0	0	67	8	9	0	5	52	0	0	8					
31-40	0	33	33	0	0	0	19	50	8	0	0	19	25	0	9	0	38	17	8	0					
41-50	0	0	50	25	0	0	0	25	17	0	0	0	50	17	0	0	0	41	17	0					
51-60	0	0	8	33	18	0	0	17	58	9	0	0	17	33	0	0	0	42	25	25					
61-70	0	0	0	25	10	0	0	0	0	46	0	0	0	25	28	0	0	0	8	17					
71-80	0	0	0	17	27	0	0	0	17	36	0	0	0	8	27	0	0	0	42	0					
81 and +	0	0	0	0	45	0	0	0	0	9	0	0	0	8	36	0	0	0	0	50					
Trunk diameter (mm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-10	5	0	0	0	0	33	9	0	0	0	81	0	0	0	0	81	0	0	0	0	95	14	17	0	0
11-20	86	19	0	0	0	67	24	17	8	0	19	90	0	0	0	19	57	8	0	0	5	43	0	0	0
21-30	9	71	0	0	0	0	67	25	0	8	0	10	25	0	0	0	43	59	25	0	0	43	50	17	0
31-40	0	10	50	17	0	0	0	58	33	0	0	0	75	25	0	0	0	33	33	25	0	0	25	25	25
41-50	0	0	42	25	25	0	0	0	59	17	0	0	0	38	38	0	0	0	17	25	0	0	8	8	33
51-60	0	0	8	42	17	0	0	0	0	33	0	0	0	25	0	0	0	0	25	0	0	0	0	42	17
61-70	0	0	0	8	42	0	0	0	0	42	0	0	0	12	37	0	0	0	0	25	0	0	0	8	17
71-80	0	0	0	8	8	-	-	-	-	-	0	0	0	0	0	0	0	0	0	25	0	0	0	0	8
81 and +	0	0	0	0	8	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-



Table 3: Breakdown of *Ulmus pumila* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	90	14	0	8	0	95	0	0	0	0	86	10	0	0	0	95	0	0	0	0
101-150	10	62	8	0	0	5	76	0	0	0	14	57	0	0	0	5	57	8	0	0
151-200	0	19	50	0	0	0	24	34	8	0	0	33	42	8	0	0	43	0	0	8
201-250	0	5	34	17	9	0	0	58	8	9	0	0	25	0	0	0	0	58	17	0
251-300	0	0	0	17	10	0	0	8	25	9	0	0	25	42	19	0	0	34	0	0
301-350	0	0	8	25	18	0	0	0	42	9	0	0	0	8	9	0	0	0	17	0
351-400	0	0	0	25	0	0	0	0	17	64	0	0	8	25	9	0	0	0	25	8
401-450	0	0	0	8	36	0	0	0	0	9	0	0	0	17	18	0	0	0	33	17
451 and +	0	0	0	0	27	-	-	-	-	-	0	0	0	0	45	0	0	0	8	67

Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-100	81	10	0	0	0	100	57	8	0	0	100	24	0	0	0	67	5	8	0	0	100	90	25	0	0
101-150	14	48	0	0	0	0	43	58	8	0	0	52	25	0	13	33	62	17	0	0	0	10	50	17	10
151-200	5	33	25	0	0	0	0	34	75	17	0	24	25	25	0	0	28	25	34	12	0	0	25	75	40
201-250	0	5	42	25	0	0	0	0	17	58	0	0	25	13	13	0	5	50	8	13	0	0	0	8	40
251-300	0	4	33	50	18	0	0	0	0	25	0	0	12	0	0	0	0	0	25	12	0	0	0	0	10
301-350	0	0	0	17	55	-	-	-	-	-	0	0	13	25	13	0	0	0	33	13	-	-	-	-	-
351-400	0	0	0	8	18	-	-	-	-	-	0	0	0	25	11	0	0	0	0	50	-	-	-	-	-
401-450	0	0	0	0	9	-	-	-	-	-	0	0	0	12	25	-	-	-	-	-	-	-	-	-	-
451 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	25	-	-	-	-	-	-	-	-	-	-



Viburnum carlesii Hemsl.

See colour plate

Family	:	Caprifoliaceae
English name	:	Koreanspice viburnum
French name	:	Viorne de Carles
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This shrub, with a rounded growth habit, can attain a height of 1.5 to 2.0 m. Its erect branches make it very dense.

The young branches are pale brown to grey and pubescent. The older branches are dark brown and have a fissured appearance.

The colour of the foliage is dull green during the summer, turning purplish-red in the fall. However, this coloration is not constant from one plant to another and from one season to another. The opposite leaves are wide, oval to elliptic, short-stalked, rounded at the base, acute at the apex, irregularly toothed, pubescent on both sides and 4 to 10 cm long.

The flower buds are pink. The very fragrant white flowers, in convex terminal cymes 5 to 7 cm in diameter, appear at the beginning of the leafing period. The corolla tube opens into five lobes 10 to 12 mm in diameter. The flowering period is short.

The fruits, ovoid blue-black berries, are approximately 1 cm in diameter.

ORIGIN AND DISTRIBUTION

This species originates in Korea and was identified in 1901.

USE

Ornamental: The very early and fragrant flowering of this species makes it an excellent choice standing alone, while plantings in clumps require large spaces.

REQUIREMENTS

This species prefers moist, well-drained and slightly acidic soils. It grows well when planted in full sunlight or in a semi-shady location.

Growth is very slow and pruning is carried out after flowering.

Transplanting is more successful using the root ball method or with plants grown in pots. Only small specimens are transplanted using the bare root method.

PATHOLOGY

A bacterium called *Pseudomonas viburni* occasionally affects the foliage and causes brown spots on the leaves and young stems.

This species is more susceptible to rust when grafted.

PROPAGATION

Propagation by cuttings: Propagation of this species by cuttings is considered difficult, but cuttings taken in July and treated with a solution of IBA (8,000 ppm), take root relatively well. The freshly rooted cuttings must not be disturbed and transplanting is done after a season of dormancy.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 398 cuttings of approximately 15 cm were taken on June 29, 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 99% after 46 days. Potting was carried out on August 3 and 14 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in the sand of a cold frame on August 10 and 25. The cuttings overwintered in a frame under a thick cover of snow and the winter survival rate was 70%; 256 plants were transplanted to the nursery in May 1985 and the recovery rate was 94%. They were dug up on May 2,



1986, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 20 to 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

At several sites, frost damage occurred during the fourth winter.

Region 1

No damage occurred at the L'Assomption and Sainte-Clotilde sites, with the exception of the fourth winter, when 67% of the plants at the L'Assomption site on clay exhibited signs of frost damage on the previous year's shoot and one plant at Sainte-Clotilde suffered frost damage on the old wood. In addition, one plant was affected by field mice the second winter at the L'Assomption site on clay.

Region 2

At Sainte-Foy, only damage caused by field mice affected 25% of the plants during the third winter. One of them died the following winter.

At Deschambault, frost damage on the stem tips occurred during the fourth winter and 17% of the plants were affected. As well, mechanical breakage caused by various weather conditions damaged 5%, 33% and 67% of the plants during the second, fourth and fifth winters respectively.

At La Pocatière, the poor pedological conditions affected growth. However, most of the plants survived the first four years.

Region 3

No damage occurred at Normandin.

At Kapuskasing, frost damage occurred during the first winter, affecting one plant on the stem tips and one plant on the old wood, while one plant died. As well, 17% of the plants were damaged by mechanical breakage during the fourth winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.28 m R2 = 0.96 m R3 = 0.85 m

The La Pocatière site considerably lowered the average for region 2, for both height and width.

Categories

The average height of the shrubs after five years varied from one station to another:

1.26 - 1.50 m: Sainte-Clotilde, L'Assomption on sand and Deschambault

1.01 - 1.25 m: -

1.00 m and - : Normandin, Sainte-Foy, L'Assomption on clay, Kapuskasing and La Pocatière

Growth was slightly lower at the sites on clay soil.

The plants at Sainte-Foy were cut back to the ground following damage caused by field mice, with the result that the final height of these plants did not increase between the third and the fifth year.

In general, there was a gradual increase in height every year at all the sites.

Effect of pruning

No pruning was necessary for this species, except to remove the damaged portions.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.31 m R2 = 1.17 m R3 = 1.09 m

In region 1, the plants were as wide as they were high, while they were wider than high in the other regions.

Viburnum carlesii Hemsl.

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.51 m and + : Deschambault and Sainte-Clotilde
- 1.26 - 1.50 m: L'Assomption on sand
- 1.01 - 1.25 m: Sainte-Foy, Normandin, Kapuskasing and L'Assomption on clay
- 1.00 m and - : La Pocatière

Flowering

The first flowers appeared between May 19 and 28 in the Montreal region and the total flowering period ranged from 15 to 30 days, depending on the year.

In region 2, the first flowers were observed between May 24 and 29, i.e. five to six days later on average than in region 1, and the flowering period lasted 13 to 14 days.

At the sites in region 3, flowering was observed mainly the last two years. The first flowers appeared between May 27 and June 2 and the duration of flowering was similar to that in region 2.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The production of this species was very comparable at all the sites in the Quebec City and Montreal regions; after two years of growth, 86% to 100% of the plants had attained a height of between 51 and 100 cm. The final height attained was greater in region 1, particularly at Sainte-Clotilde. Since this species can be transplanted more successfully using the root ball method, it should not be grown in the open field for more than three years. To obtain large specimens, it would be preferable to grow it in containers in order to facilitate regeneration of

growth. Soils that are too heavy or poorly drained considerably slow its growth.

Use

This plant seems perfectly adapted to all the types of climate encountered in this test. The damage observed was occasional and light. However, this species was susceptible to breakage of the stems after heavy snowfalls or accumulation of ice. The results of this test demonstrate that this species performs very well as far north as zone 2a and its zone rating of 5b assigned by Sherk and Buckley is modified to 2a. This species has slightly slower growth in colder climates, but its ornamental features are preserved.

BIBLIOGRAPHICAL REFERENCES

4, 12, 27, 49, 72, 86, 101

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Jacques Côté, Biol.



Table 1: Frequency of winter damage observed on *Viburnum carlesii* from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	99								1		1
L'Assomption-sand	87		13								13
Sainte-Clotilde	99						1				1
REGION 2											
Deschambault	76	3						21			24
Sainte-Foy	94					1			5		6
La Pocatière ^b	65	11		4		20					35
REGION 3											
Normandin	100										0
Kapusking	94	1						2	3		6

- ^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 splitting |
| 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 types 3, 7 and 14 occurred for this species.

^b All the plants at this site died during the fifth winter, particularly because of asphyxiation of the roots.

Table 2: Breakdown of *Viburnum carlesii* plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	100	5	0	0	0	100	5	0	0	0	100	0	0	0	0										
51-100	0	95	67	25	0	0	95	100	100	92	0	100	25	0	0										
101-150	0	0	33	75	92	0	0	0	0	8	0	0	75	100	42										
151-200	0	0	0	0	8	-	-	-	-	-	0	0	0	0	58										
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	5	0	10	0	100	14	0	0	0	100	100	75	67	33	100	61	8	0	0	100	95	58	0	0
51-100	0	95	83	70	40	0	86	100	0	0	0	0	25	33	67	0	39	92	100	42	0	5	42	100	100
101-150	0	0	17	20	60	0	0	0	100	100	-	-	-	-	-	0	0	0	0	58	-	-	-	-	-
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Table 3: Breakdown of *Viburnum carlesii* plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	0	0	0	0	100	29	0	0	0	100	0	0	0	0
51-100	0	100	75	0	0	0	71	100	83	50	0	67	17	0	0
101-150	0	0	25	83	75	0	0	0	17	50	0	33	83	67	50
151-200	0	0	0	17	25	-	-	-	-	-	0	0	0	33	50

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	100	5	0	20	0	100	5	0	0	0	100	100	75	33	17	100	33	0	0	0	100	90	8	0	0
51-100	0	90	17	60	40	0	95	50	8	0	0	0	25	67	83	0	67	75	75	17	0	10	92	100	8
101-150	0	5	83	20	50	0	0	50	92	50	-	-	-	-	-	0	0	25	25	83	0	0	0	0	92
151-200	0	0	0	0	10	0	0	0	0	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Viburnum lantana L.

See colour plate

Family	:	Caprifoliaceae
English name	:	Wayfaringtree viburnum
French name	:	Viorne commune or viorne cotonneuse
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This vigorous shrub, with an erect growth habit and rounded crown, can attain a height of 3.0 to 4.5 m.

The young stems, light beige and pubescent, become grey and covered with lenticels as they get older. The buds are reddish.

The leaves are opposite, simple, cordate, ovate to rectangular-ovate, finely serrate, crispate and 5 to 12 cm long. They are dark green or greyish-green and turn crimson in the fall. The leaves, branches and buds are covered with a fine grey pubescence.

Small, creamy white flowers, grouped into flattened corymbs of 5 to 10 cm in diameter, appear in late spring and early summer. The fruits, edible berries, are yellow and turn red then black when ripe in early fall. They remain on the branches for part of the winter.

The root system is fibrous, which facilitates transplanting.

ORIGIN AND DISTRIBUTION

The species is originally from Europe and western Asia. It has occasionally escaped from cultivation in the eastern United States.

USE

Ornamental: This species is often used as a hedge or screen but it is mainly of interest for planting in clumps. Its berries are a choice food of birds.

REQUIREMENTS

This species prefers rich, well-drained soils, but adapts more easily to dry, limestone soils than the other viburnums. In the sun, flowering is more abundant and the growth habit more regular; however, this species does tolerate shade. It does not tolerate any spraying of sulphur-based pesticides.

PATHOLOGY

To our knowledge, no serious disease appears to affect this species.

PROPAGATION

Seedlings: This species is often propagated by seeds.

Propagation by cuttings: Softwood cuttings take root easily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: The seeds were harvested on September 15, 1981 and sown outside on November 10. In the summer of 1983, the seedlings were potted and kept in frames until the spring of 1985. They were then wrapped and kept in a cellar until they were shipped a few days later.

Inclusion in test network: Young seedlings 9 to 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Seedling mortality was fairly high at La Pocatière the second winter and at Kapuskasing the fourth winter.



This plant was very little affected by weather conditions; the only damage was mechanical breakage caused by snow at three of the nine sites, as well as frost damage on the stem tips of a few plants.

Region 1

The seedlings at Sainte-Clotilde did not suffer any damage. At the two L'Assomption sites, only one plant at each site suffered frost damage on the stem tips. At Sainte-Anne-de-Bellevue, 40% of the seedlings suffered this type of damage following the first winter.

Region 2

At Sainte-Foy, one-third of the seedlings suffered light frost damage on the stem tips the last winter.

At Deschambault, snow accumulation caused damage on 17% and 75% of the seedlings the last two winters.

At La Pocatière, the second winter was more difficult, since 43% of the seedlings died. However, six of the nine seedlings were in the third replication and this mortality could be related more to a terrain effect than to climatic reasons.

Region 3

At Normandin, the seedlings suffered little or no damage.

At Kapuskasing, 25% of the seedlings died following the fourth winter and 70% of the living seedlings suffered severe mechanical breakage the last winter.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.49 m R2 = 1.44 m R3 = 1.14 m

The height of the seedlings in region 3 was lower than in the other regions.

Categories

The average height of the shrubs after five years varied from one site to another:

- 1.76 - 2.00 m: Sainte-Clotilde
- 1.51 - 1.75 m: Sainte-Anne-de-Bellevue, Sainte-Foy and Deschambault
- 1.26 - 1.50 m: L'Assomption on sand, La Pocatière and L'Assomption on clay
- 1.01 - 1.25 m: Normandin and Kapuskasing

There was great homogeneity among the seedlings at the same site. In addition, the seedlings at Sainte-Clotilde were clearly taller than those at the other sites by the second season.

The seedlings on sites with clay soil exhibited poorer growth.

Effect of pruning

Very little pruning was carried out on this species, other than pruning for shaping at the beginning of the second growing season.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.41 m R2 = 1.33 m R3 = 1.03 m

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.51 - 1.75 m: Sainte-Foy, Sainte-Clotilde and Sainte-Anne-de-Bellevue
- 1.26 - 1.50 m: L'Assomption on clay and on sand
- 1.01 - 1.25 m: Deschambault, Kapuskasing and La Pocatière
- 1.01 m and - : Normandin

Flowering

In region 1, the flowering period began between May 18 and 23, depending on the year, and lasted 8 to 16 days. Anthesis occurred quickly, with the result that mid-flowering (50% of the buds in flower) occurred two to three days after the appearance of the first flower.

Viburnum lantana L.

BIBLIOGRAPHICAL REFERENCES

3, 23, 27, 34, 47, 56, 60, 71, 86, 88

In region 2, the flowering period began between May 25 and 30 and lasted 11 to 20 days. The flowering period therefore began one week later and lasted slightly longer than in region 1. However, mid-flowering occurred seven days after the appearance of the first flowers. The peak flowering period lasted 5 to 13 days.

In region 3, the beginning of flowering was observed between June 2 and 7 and the flowering period lasted 12 to 18 days. Mid-flowering occurred seven days after the appearance of the first flowers. The peak flowering period lasted five to 11 days.

On a few occasions, the seedlings reformed a few inflorescences in August.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

This fast-growing species can be produced at all the sites; 40% to 100% of the seedlings at all the sites had attained a marketable height category of 51 to 100 cm after two years. Still, the tallest seedlings were obtained at Sainte-Clotilde, every year.

However, this species grows more slowly at sites with clay soil since, by the first year, the L'Assomption on clay, La Pocatière, Kapuskasing and Normandin sites yielded shorter and narrower seedlings.

Use

The zone rating of 2b mentioned by Sherk and Buckley can be revised to 2a. However, during an exceptionally cold winter, plants used in a very exposed location could die in the northernmost zone.

This very fast-growing species requires little or no pruning, is not affected by insects and produces beautiful foliage. The fact that it requires little maintenance is one of its advantages.

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Table 1: Frequency of winter damage observed on *Viburnum lantana* from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	98	2								2	
L'Assomption-sand	99	1								1	
Ste-Anne-de-Bellevue	92	8								8	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	77							23		23	
Sainte-Foy	94	6								6	
La Pocatière	91	1				8				9	
REGION 3											
Normandin	98							2		2	
Kapuskasing	81					5		14		19	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

No damage of types 3, 4, 5, 6, 7, 9 and 11 occurred for this species.

Table 2: Breakdown of *Viburnum lantana* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	62	10	0	8	0	66	10	0	0	0	35	0	0	0	0	57	0	0	0	0					
51-100	38	85	58	33	8	34	90	50	25	17	65	15	8	8	8	43	67	50	8	0					
101-150	0	5	42	59	75	0	0	50	75	75	0	65	50	17	17	0	33	50	50	59					
151-200	0	0	0	0	17	0	0	0	0	8	0	20	42	67	50	0	0	0	42	33					
201 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	8	25	0	0	0	0	8					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	29	5	0	0	0	48	0	0	0	0	100	62	11	0	0	95	24	0	0	0	100	48	0	0	0
51-100	71	76	8	8	0	52	72	33	8	0	0	38	89	44	22	5	76	83	42	17	0	52	83	55	45
101-150	0	19	92	84	72	0	28	67	59	50	0	0	0	56	56	0	0	17	58	83	0	0	17	45	55
151-200	0	0	0	8	28	0	0	0	33	50	0	0	0	0	22	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Table 3: Breakdown of *Viburnum lantana* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	100	10	8	0	0	100	19	0	0	0	NA	0	0	0	0	NA	NA	NA	0	0
41-80	0	80	42	0	8	0	81	34	25	0	NA	35	8	0	0	NA	NA	NA	0	0
81-120	0	10	50	92	25	0	0	50	67	25	NA	65	50	25	25	NA	NA	NA	33	25
121-160	0	0	0	8	67	0	0	16	8	67	NA	0	42	50	42	NA	NA	NA	67	33
161 and +	-	-	-	-	-	0	0	0	0	8	NA	0	0	25	33	NA	NA	NA	0	42

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-40	100	10	0	0	0	NA	38	0	0	0	NA	100	22	0	0	NA	57	0	0	0	100	76	0	0	0
41-80	0	52	0	0	0	NA	53	42	25	8	NA	0	78	44	11	NA	43	50	0	8	0	24	100	9	0
81-120	0	38	17	33	0	NA	9	58	50	34	NA	0	0	56	78	NA	0	50	100	92	0	0	0	91	89
121-160	0	0	83	67	33	NA	0	0	25	58	NA	0	0	0	11	NA	-	-	-	-	0	0	0	0	11
161 and +	0	0	0	0	67	NA	-	-	-	-	NA	-	-	-	-	NA	-	-	-	-	-	-	-	-	-



Viburnum Lentago L.

See colour plate

Family	:	Caprifoliaceae
English name	:	Nannyberry, sheepberry
French name	:	Alisier, bourdaine
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This indigenous shrub or small tree, with an erect growth habit, can attain a height of 4.5 to 6.0 m and sometimes more.

The trunk is narrow and crooked. The crown is open, irregular and composed of a few arched branches. The bark is greyish-brown with small, irregular scales.

The leaves are deciduous, opposite, simple, ovate or narrowly oval, finely toothed and acute. The blade is 5.0 to 12.5 cm long. The upper surface is glossy green and the lower surface is dotted with small dark brown spots. The foliage turns crimson in the fall. The grooved petiole is bordered on each side by narrow extensions of the blade.

The branches are slender, smooth and pale brown. They give off an unpleasant odour when broken.

The leaf buds are narrow, grey-brown and covered with two types of scales. The flower buds are entirely covered by two scales and clustered at the tips of the stems.

In late spring, the arched branches are covered with small, fertile, white flowers clustered in almost sessile flattened corymbs 7.5 to 11.0 cm wide.

In early fall, the berries gradually change from green to yellow, to red and then to bluish-black, and all the colours can be found on the same inflorescence. The fruits are approximately 12 mm in diameter; they are thin-fleshed, sweet and edible. The pits are quite flattened.

ORIGIN AND DISTRIBUTION

This indigenous species is very common in western Quebec. It ranges from southwestern New Brunswick to eastern Saskatchewan within the Great Lakes-St. Lawrence Deciduous Forest Region and in certain southern sectors of the Boreal Region. In the United States, it is found from southern Georgia to Mississippi. It is generally found along rivers and lakes together with other species. It has been cultivated since 1761.

USE

Ornamental: This species is used standing alone, in clumps or in a grid for its fruits and its fall foliage. It can also be cultivated as a single stem, but it suckers easily and is difficult to maintain as a tree.

Economic: The wood has no commercial value.

Ornithology: The fruits attract birds.

REQUIREMENTS

This species prefers rich, well-drained, non-swampy soils. It tolerates urban conditions and semi-sunny sites. It tends to sucker.

PATHOLOGY

The foliage is susceptible to downy mildew (*Plasmora viburnis*) when the plant is placed in the shade or exposed to conditions of high humidity. This produces a gradual defoliation which slows the growth of the plant.

PROPAGATION

Seedlings: The seeds must be stratified for 150 to 270 days at temperatures between 18°C and 25°C, and then for 50 to 120 days at 4°C.

Propagation by cuttings: Softwood cuttings take root easily.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec



Propagation technique: The seeds were harvested on October 10, 1981 and sown outside on November 10. The seedlings were potted in the summer of 1983 and cultivated in a frame. In the spring of 1985, they were wrapped and shipped to the test sites.

Inclusion in test network: Young seedlings 5 to 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Winter damage was light at all the sites and was more frequent at the two sites in region 3.

Region 1

At the two L'Assomption sites, no damage occurred four years out of five; 15% of the seedlings suffered frost damage on the stem tips the first winter at one site, and one plant suffered mechanical breakage at the other site.

At Sainte-Clotilde, only one plant suffered frost damage on the previous year's shoot the first winter.

At Sainte-Anne-de-Bellevue, some of the seedlings suffered frost damage on the stem tips three years out of five.

Region 2

At Deschambault, only mechanical breakage occurred the last two winters on 17% and 50% of the seedlings.

At Sainte-Foy, one plant died following the first winter; 47% and 32% of the seedlings suffered light frost damage on the stem tips following the first two winters.

At La Pocatière, there was no damage four years out of five; during the second winter, 50% of the seedlings suffered frost damage on the stem tips, 10% suffered frost damage on the previous year's shoot and 20% died. The most severe damage occurred on the seedlings in the first replication and this could be related to a terrain effect.

Region 3

At Normandin, only mechanical breakage and frost damage on the stem tips affected the seedlings four winters out of five.

At Kapuskasing, mortality occurred following the first two winters, mechanical breakage the last winter and frost damage on the stem tips following the second, third and fourth winters. More than 50% of the seedlings did not suffer any damage every year.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.92 m R2 = 1.43 m R3 = 1.18 m

The height of the seedlings in region 1 was clearly greater than that of the seedlings in the other regions.

Categories

The average height of the shrubs after five years varied from one site to another.

2.26 m and + : L'Assomption on sand
 2.01 - 2.25 m: Sainte-Clotilde and Sainte-Anne-de-Bellevue
 1.76 - 2.00 m: -
 1.51 - 1.75 m: Sainte-Foy
 1.26 - 1.50 m: Deschambault, Normandin, La Pocatière and L'Assomption on clay
 1.01 - 1.25 m: Kapuskasing

The seedlings at L'Assomption on sand, Sainte-Clotilde and Sainte-Anne-de-Bellevue were clearly taller than the seedlings at the other sites.

All the sites on clay soil produced smaller shrubs.

Effect of pruning

Pruning was nil at all the sites except Sainte-Foy and Normandin, where it was approximately 25% every year.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.28 m R2 = 1.13 m R3 = 0.87 m



Viburnum Lentago L.

The seedlings in region 1 were statistically wider than those in region 3.

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.26 - 1.50 m: L'Assomption on sand, Sainte-Clotilde, Sainte-Anne-de-Bellevue and Sainte-Foy
- 1.01 - 1.25 m: Deschambault
- 1.01 m and - : La Pocatière, L'Assomption on clay, Normandin and Kapuskasing

The width of the shrubs was not a production or selling criterion in this case, since it varied little from one site to another.

Flowering

This species flowered very little during the testing period. Flowering was observed at three of the nine sites during the last year of evaluation, i.e. during the fifth year. The first flowers appeared between May 31 and June 6 in region 1 and around June 6 in region 2. No flowering was observed at the sites in region 3. The flowering period lasted approximately 7 to 13 days and the seedlings attained full flowering two or three days after the appearance of the first flowers.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

As with *Viburnum trilobum*, the growth of this species was very rapid. After two years of growth, 90% of the seedlings at all the sites, except La Pocatière and Kapuskasing, had attained a height of between 51 and 150 cm. However, the shrubs at Sainte-Clotilde were generally larger and 75% of them were between 100 and

150 cm high. This species clearly grows more slowly on clay soils.

Use

Very similar to *Viburnum trilobum*, this species seems slightly more resistant to the climatic conditions at Kapuskasing. However, on the whole, damage was more frequent at this site. This region seems to be the probable limit of use and hardiness of this species and hence its zone rating can be specified as 2a.

Under colder climatic conditions, *Viburnum trilobum* [Tr: sic] has significantly slower growth in height and in width without, however, losing its ornamental features.

BIBLIOGRAPHICAL REFERENCES

- 3, 21, 27, 41, 47, 51, 56, 60, 65, 71, 81, 86

WRITTEN BY

- Claude Richer, Agr.
- Jacques-André Rioux, Agr.
- Jacques Côté, Biol.



Table 1: Frequency of winter damage observed on *Viburnum Lentago* from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	98							2		2	
L'Assomption-sand	97	3								3	
Ste-Anne-de-Bellevue	78	22								22	
Sainte-Clotilde	99		1							1	
REGION 2											
Deschambault	85	2						13		15	
Sainte-Foy	83	16				1				17	
La Pocatière	84	10	2			4				16	
REGION 3											
Normandin	66	29						5		34	
Kapuskasing	68	17	1			5		9		32	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

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

Table 2: Breakdown of *Viburnum Lentago* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-50	86	10	0	0	0	90	14	0	0	0	43	5	0	0	0	62	10	0	0	0					
51-100	14	50	25	17	0	10	86	67	58	25	57	19	8	8	16	38	52	17	8	0					
101-150	0	40	50	25	8	0	0	33	42	58	0	66	33	9	0	0	38	75	33	17					
151-200	0	0	25	42	17	0	0	0	0	17	0	10	50	58	17	0	0	8	42	33					
201-250	0	0	0	16	33	-	-	-	-	-	0	0	9	25	50	0	0	0	17	33					
251-300	0	0	0	0	42	-	-	-	-	-	0	0	0	0	17	0	0	0	0	17					
Height (cm)	REGION 2																								
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	60	10	0	0	0	67	10	0	0	0	100	42	30	0	0	81	14	8	0	0	100	95	9	9	0
51-100	40	80	50	8	0	33	90	67	17	17	0	58	70	50	20	19	67	42	42	17	0	5	91	55	18
101-150	0	10	50	75	58	0	0	33	75	33	0	0	0	50	40	0	19	50	58	58	0	0	0	36	82
151-200	0	0	0	17	42	0	0	0	8	50	0	0	0	0	40	0	0	0	0	25	0	0	0	0	0
201-250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
251-300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Table 3: Breakdown of *Viburnum Lentago* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	55	25	17	0	100	100	25	25	0	NA	86	17	0	0	NA	NA	NA	0	0
51-100	0	45	75	33	25	0	0	75	67	75	NA	14	75	25	25	NA	NA	NA	25	17
101-150	0	0	0	50	16	0	0	0	8	25	NA	0	8	75	33	NA	NA	NA	58	50
151-200	0	0	0	0	42	-	-	-	-	-	NA	0	0	0	42	NA	NA	NA	17	25
201 and +	0	0	0	0	17	-	-	-	-	-	NA	0	0	0	0	NA	NA	NA	0	8

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-50	100	80	25	0	0	NA	72	NA	8	0	NA	100	80	20	0	NA	100	8	8	17	100	100	100	18	9
51-100	0	20	67	58	33	NA	28	NA	92	42	NA	0	20	70	50	NA	0	92	58	58	0	0	0	82	82
101-150	0	0	8	42	33	NA	0	NA	0	58	NA	0	0	10	50	NA	0	0	25	25	0	0	0	0	9
151-200	0	0	0	0	34	NA	-	NA	-	-	NA	-	-	-	-	NA	0	0	9	0	-	-	-	-	-
201 and +	-	-	-	-	-	NA	-	NA	-	-	NA	-	-	-	-	NA	-	-	-	-	-	-	-	-	-



Viburnum opulus 'Nanum'

See colour plate

Family	:	Caprifoliaceae
English name	:	Dwarf European cranberrybush
French name	:	Viorne obier naine
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This globular dwarf shrub can attain a height of 0.85 m and a width of up to 1.20 m. It is composed of several small, slender and delicate stems.

The foliage is very dense and dark green, becoming purplish in the fall. The leaf is three-lobed. According to the literature, flowering is fairly rare and fruiting almost non-existent.

ORIGIN AND DISTRIBUTION

This cultivar is of European origin and is found as far afield as northern Africa and Asia.

USE

Ornamental: This cultivar, like the type species, is used as a low hedge, in clumps or standing alone in rock gardens.

REQUIREMENTS

This cultivar does not tolerate drought or poorly drained soils. In wet weather, it develops spots on the foliage. However, it tolerates shade well.

PATHOLOGY

It is necessary to monitor for insect infestation, which causes rapid and severe defoliation.

PROPAGATION

Propagation by cuttings: This is the sole method of propagation for this cultivar.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 344 cuttings of 15 cm were taken on June 29, 1984 and treated with a solution of 4,000 ppm IBA. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%); the rooting rate was 99% after three weeks. The rooted cuttings were potted on July 26 and placed in a frame on August 10. Growth continued until September. They overwintered in an open frame under a thick cover of snow and the survival rate was 100%. They were shipped on May 7, 1985.

Inclusion in test network: Young plants 8 to 10 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

Winter damage

Mortality was low but was observed at almost all the sites. Apart from mortality, the occasional winter damage was limited to frost damage on the shoot tips. However, at Kapuskasing frost damage was significantly more frequent and severe.

Region 1

No plants died at Sainte-Anne-de-Bellevue and, at the two L'Assomption sites, mortality was limited to only one plant at each site the first winter. All the plants suffered frost damage on the stem tips the fourth winter at Sainte-Anne-de-Bellevue.

At Sainte-Clotilde, two plants died following the second winter. No damage was observed on the other plants during the testing period.

Region 2

No damage was observed at Sainte-Foy or at La Pocatière except on one plant only at each site.

At Deschambault, mechanical breakage was observed on 17% of the plants following the fourth winter and frost



damage on the stem tips on all the plants was observed following the third and last winters.

Region 3

At Normandin, none of the living plants suffered frost damage. A few plants died during testing, including two after the second winter and a third the following winter. All three plants were in replication 1.

At Kapuskasing, winter damage was more frequent and more severe, particularly the first three winters: frost damage down to the level of snow cover was observed on 11% of the plants the second winter and frost damage down to the ground level was observed respectively on 5%, 11% and 23% of the plants the first three winters. One-third of the plants in the test died following the second winter and one plant died in each of the following two winters. No damage was observed on the living plants the last two winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.62 m R2 = 0.51 m R3 = 0.37 m

The height of the plants at Kapuskasing considerably lowered the average for region 3.

Categories

The average height of the shrubs after five years varied from one site to another:

71 cm and +:	Sainte-Clotilde
61 - 70 cm:	Sainte-Anne-de-Bellevue
51 - 60 cm:	Sainte-Foy, L'Assomption on sand and on clay and Normandin
41 - 50 cm:	La Pocatière and Deschambault
31 - 40 cm:	-
21 - 30 cm:	Kapuskasing

The height of the shrubs was quite variable from one site to another.

Most of the shrubs at Sainte-Clotilde and a few at Sainte-Anne-de-Bellevue had attained the potential height of this cultivar after five years.

Effect of pruning

No pruning was necessary on this cultivar.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 0.82 m R2 = 0.70 m R3 = 0.45 m

The width of the plants at Kapuskasing considerably lowered the average for region 3.

Categories

The average width of the shrubs after five years varied from one site to another:

91 cm and + :	Sainte-Clotilde
81 - 90 cm:	-
71 - 80 cm:	Sainte-Foy, L'Assomption on sand, Sainte-Anne-de-Bellevue, La Pocatière and L'Assomption on clay
61 - 70 cm:	Normandin
51 - 60 cm:	Deschambault
41 - 50 cm:	-
31 - 40 cm:	Kapuskasing

Most of the plants at Sainte-Clotilde had attained a width of between 0.90 and 1.20 m.

At Kapuskasing, the width of the plants in two of the three replications varied from 30 to 50 cm. The plants in the third replication were significantly smaller, bringing down the average for this site.

Flowering

Flowering of this cultivar was observed at five of the nine sites the last two years only: three of the four sites in the Montreal region, one of the three sites in region 2 and one site in region 3.

The plants began to flower between May 29 and June 5 at Sainte-Anne-de-Bellevue, but the first flowers appeared around June 9 at L'Assomption. The flowering period lasted 15 to 20 days and mid-flowering occurred four days after the beginning of flowering. The peak flowering period lasted 10 to 15 days.



***Viburnum opulus* 'Nanum'**

This cultivar seems to become established better the first year on lighter soils.

BIBLIOGRAPHICAL REFERENCES

3, 22, 27, 47, 60, 71, 86

At Sainte-Foy, flowering began around May 30 and lasted until June 26, i.e. approximately 26 or 27 days. The peak flowering period began some 12 days after the beginning of flowering and lasted nearly half of the flowering period.

At Normandin, the first flowers appeared between June 15 and 21 and the flowering period lasted approximately 15 to 19 days. The peak flowering period was concentrated in the last 10 days of flowering, i.e. a duration equivalent to half of the flowering period.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

There was little difference between the sites the first two years, since the plants were still small; the Deschambault, La Pocatière, Normandin and Kapuskasing sites produced plants between 10 and 20 cm high, while the plants at the other sites ranged from 11 to 30 cm in height.

The third year was decisive; the plants at the four sites in region 1 as well as those at Sainte-Foy were significantly larger and those at Kapuskasing smaller. Production was therefore faster in regions with warmer climatic conditions.

Annual growth of this cultivar is regular and the greatest differences between the sites were apparent in the third year.

Use

The zone rating of 2b mentioned by Sherk and Buckley for this species and its cultivars seems appropriate.

The climatic conditions at Kapuskasing (zone 2a) caused damage and mortality of several young plants the first three winters, which is an indicator of the hardiness limit of the young plants of this cultivar.

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.



Table 1: Frequency of winter damage observed on *Viburnum opulus* 'Nanum' from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	99					1				1	
L'Assomption-sand	99					1				1	
Ste-Anne-de-Bellevue	80	20								20	
Sainte-Clotilde	98					2				2	
REGION 2											
Deschambault	46	50						4		54	
Sainte-Foy	98	2								2	
La Pocatière	99					1				1	
REGION 3											
Normandin	96					4				4	
Kapusksing	67	10	4	2	8	9				33	

^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 splitting
 10 = mechanical breakage related to weather conditions
 11 = damage by rodents

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

Table 2: Breakdown of *Viburnum opulus* 'Nanum' plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																													
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue														
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89										
0-10	81	5	0	0	0	71	0	0	0	0	89	0	0	0	0	90	15	0	0	0										
11-20	19	60	0	0	0	29	70	0	0	0	11	75	8	0	0	10	25	0	0	0										
21-30	0	35	17	0	0	0	30	33	0	0	0	25	0	8	0	0	60	25	0	0										
31-40	0	0	58	17	8	0	0	58	33	0	0	0	25	0	8	0	0	25	25	8										
41-50	0	0	17	50	25	0	0	9	67	42	0	0	67	8	0	0	0	42	17	17										
51-60	0	0	0	17	33	0	0	0	0	50	0	0	0	75	0	0	0	8	50	8										
61-70	0	0	8	16	17	0	0	0	0	8	0	0	0	9	17	0	0	0	8	34										
71-80	0	0	0	0	17	-	-	-	-	-	0	0	0	0	58	0	0	0	0	33										
81 and +	-	-	-	-	-	-	-	-	-	-	0	0	0	0	17	-	-	-	-	-										
Height (cm)	REGION 2															REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-10	33	0	0	0	0	76	5	0	0	0	95	21	0	0	0	94	56	20	0	0	62	41	50	33	18					
11-20	67	43	0	0	0	24	86	0	17	0	5	79	0	0	0	6	38	20	10	0	38	59	42	50	27					
21-30	0	57	25	0	0	0	9	83	58	0	0	0	83	0	0	0	6	50	10	0	0	0	8	17	37					
31-40	0	0	67	8	0	0	0	17	25	58	0	0	17	100	0	0	0	10	50	20	0	0	0	0	18					
41-50	0	0	8	92	8	0	0	0	0	25	0	0	0	0	83	0	0	0	30	30	-	-	-	-	-					
51-60	0	0	0	0	50	0	0	0	0	17	0	0	0	0	17	0	0	0	0	50	-	-	-	-	-					
61-70	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
71-80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
81 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					



Table 3: Breakdown of *Viburnum opulus* 'Nanum' plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	100	45	0	0	0	100	75	0	0	0	89	25	8	0	0	100	25	0	0	0
21-40	0	55	25	25	25	0	25	50	0	0	11	75	0	8	8	0	75	17	8	0
41-60	0	0	75	50	8	0	0	50	83	17	0	0	92	8	0	0	0	83	42	25
61-80	0	0	0	25	0	0	0	0	17	66	0	0	0	75	0	0	0	0	50	25
81-100	0	0	0	0	67	0	0	0	0	17	0	0	0	9	92	0	0	0	0	50

Width (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskaing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	95	14	0	0	0	100	14	8	0	0	100	37	0	0	0	100	100	30	10	0	100	82	82	75	27
21-40	5	86	25	0	0	0	86	75	33	8	0	63	100	8	0	0	0	60	30	10	0	18	18	25	63
41-60	0	0	75	50	8	0	0	17	58	58	0	0	0	92	0	0	0	10	60	40	0	0	0	0	10
61-80	0	0	0	50	42	0	0	0	9	34	0	0	0	0	92	0	0	0	0	50	-	-	-	-	-
81-100	0	0	0	0	50	-	-	-	-	-	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-



Viburnum opulus 'Roseum'

See colour plate

Family	:	Caprifoliaceae
English name	:	European snowball
French name	:	Boule de neige, obier stérile
Synonym	:	<i>Viburnum opulus</i> var. <i>sterile</i>
Category	:	Deciduous plant
Subdivision	:	Shrub

BOTANICAL DESCRIPTION

This globular shrub can attain a height of up to 3 m.

The foliage is light green in summer and turns red in the fall.

The inflorescences develop from lateral shoots on two-year-old wood.

The flowers, green when they form, subsequently become creamy white. They are very fragrant, almost all sterile, and grouped in a globular, pendent inflorescence 5 to 8 cm in diameter. Flowering, which occurs in June, is impressive.

ORIGIN AND DISTRIBUTION

This old European variety was widely used in the colonies.

USE

Ornamental: This cultivar can be used in clumps or standing alone for its spectacular June flowering.

REQUIREMENTS

This cultivar, like the type species, prefers sunny exposures.

PATHOLOGY

This cultivar is very susceptible to attacks by aphids, which deform the young leaves and the stems.

PROPAGATION

Propagation by cuttings: Propagation of this species by cuttings is considered easy.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 420 cuttings of approximately 15 cm were taken on June 29, 1984 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 100% after 41 days. Potting was carried out on July 26 and August 9 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in the sand of a cold frame on August 5 and 15. The plants overwintered in the open frame under a thick cover of snow and the winter survival rate was 99%; 256 plants were transplanted to the nursery in May 1985 and the recovery rate was 98%. They were dug up on May 2 1986, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 35 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

No mortality was observed during the testing period.

Region 1

At the two L'Assomption sites, winter damage occurred during the first winter only, affecting all the plants on the stem tips. No other damage was observed.



At Sainte-Clotilde, frost damage on the stem tips was observed on 67% of the plants during the first and third winters.

Region 2

At Sainte-Foy, frost damage on the stem tips was observed during the first two winters, while at Deschambault this type of frost damage occurred on 60% to 90% of the plants every winter. In addition, a few plants were affected by mechanical breakage the last two winters.

At La Pocatière, despite unfavourable soil conditions, damage was limited to frost damage on the stem tips on 60% to 100% of the plants, except the first winter, when all the plants suffered frost damage on the previous year's shoot or above the level of snow cover.

Region 3

At Normandin, the plants exhibited signs of frost damage on the stem tips every winter. As well, 60% of the plants suffered frost damage on the previous year's shoot the first and last winters.

At Kapuskasing, behaviour was very similar to that at Normandin. However, frost damage on the previous year's shoot occurred the third and fifth winters.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.60 m R2 = 1.36 m R3 = 0.98 m

The plants in region 1 were the largest.

Categories

The average height of the shrubs after five years varied from one station to another:

1.76 m and + : L'Assomption on sand
 1.51 - 1.75 m: Sainte-Clotilde
 1.26 - 1.50 m: Sainte-Foy, Deschambault and L'Assomption on clay
 1.01 - 1.25 m: La Pocatière and Normandin
 1.00 m and - : Kapuskasing

The height of the plants was closely related to climatic and soil conditions. Height was greater at the sites where the hardiness zone was favourable.

Effect of pruning

Pruning varied considerably from one site to another. It was approximately 50% of the total height the last two years at Normandin and Kapuskasing. It was approximately 15% to 30% at the other sites, depending on the year.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.32 m R2 = 1.21 m R3 = 0.98 m

The plants in region 1 were the widest. The width, like the height of the plants, increased regularly over the years.

Categories

The average width of the shrubs after five years varied from one station to another:

1.51 m and + : L'Assomption on sand
 1.26 - 1.50 m: Deschambault and Sainte-Clotilde
 1.01 - 1.25 m: Sainte-Foy, L'Assomption on clay, Normandin and La Pocatière
 1.00 m and - : Kapuskasing

Flowering

The first flowers were observed between May 20 and 25 at the stations in region 1. They appeared 8 to 10 days later in region 2 and 16 to 20 days later at Normandin.

The total flowering period lasted 20 to 35 days, depending on the year, and full flowering occurred four to five days after opening of the first flowers.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.



***Viburnum opulus* 'Roseum'**

Production

This cultivar can be produced in all the regions except at Kapuskasing. After two years of testing, 90% to 100% of the plants had attained a height of between 51 and 100 cm at each of these sites. However, from the third season, annual growth was quite different from one region to another.

Use

The zone rating of *Viburnum opulus* and its cultivars was established at 2b by Sherk and Buckley. The results of this test demonstrated a similar growth and hardiness potential at the two sites in zone 2, since no mortality and no severe frost damage were observed. However, the previous year's shoot was affected by frost damage one winter out of two or three. In addition, under colder climatic conditions, the growth of the plants was slower and, at Kapuskasing, flowering was more scattered and less regular from one year to another. This cultivar can be assigned a survival rating of 2a, although it must be borne in mind that the expression of its ornamental features can be more or less diminished in this zone depending on the year.

BIBLIOGRAPHICAL REFERENCES

4, 12, 27, 34, 49, 50, 86, 102

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.



Table 1: Frequency of winter damage observed on *Viburnum opulus* 'Roseum' from 1986 to 1991

Test site	No damage 1	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
		2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	80	20									20
L'Assomption-sand	80	20									20
Sainte-Clotilde	72	28									28
REGION 2											
Deschambault	20	74						6			80
Sainte-Foy	63	37									37
La Pocatière	15	65	13	7							85
REGION 3											
Normandin	2	73	25								98
Kapuskasing	0	80	20								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 splitting |
| 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 types 3, 5, 7, 8, 9, 11 and 14 occurred for this species.

Table 2: Breakdown of *Viburnum opulus* 'Roseum' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	81	0	0	0	0	100	0	0	0	0	62	0	0	0	0
51-100	19	100	17	0	0	0	100	100	58	8	38	95	17	8	0
101-150	0	0	83	67	0	0	0	0	42	84	0	5	83	75	34
151-200	0	0	0	33	100	0	0	0	0	8	0	0	0	17	66
Height (cm)	REGION 2														
	Sainte-Foy					Deschambault					La Pocatière				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	29	0	0	0	0	71	0	0	0	0	100	100	8	0	0
51-100	71	81	8	75	0	29	95	92	75	0	0	0	92	67	25
101-150	0	19	92	25	58	0	5	8	25	75	0	0	0	33	58
151-200	0	0	0	0	42	0	0	0	0	25	0	0	0	0	17
Height (cm)	REGION 3														
	Normandin					Kapuskasing									
	86	87	88	89	90	86	87	88	89	90					
0-50	52	10	0	0	8	100	76	8	0	0					
51-100	48	75	8	25	33	0	24	83	92	75					
101-150	0	15	92	75	59	0	0	9	8	25					
151-200	-	-	-	-	-	-	-	-	-	-					



Table 3: Breakdown of *Viburnum opulus* 'Roseum' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	90	0	0	0	0	90	45	0	0	0	100	5	0	0	0
51-100	10	100	83	8	0	10	55	100	50	17	0	95	42	33	0
101-150	0	0	17	92	42	0	0	0	50	83	0	0	58	67	100
151-200	0	0	0	0	58	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasig				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	76	0	0	0	0	86	14	0	0	0	100	100	8	8	0	95	29	0	0	0	100	90	17	0	0
51-100	24	71	67	75	8	14	86	92	100	8	0	0	92	92	33	5	71	42	75	33	0	10	83	92	100
101-150	0	29	33	25	83	0	0	8	0	83	0	0	0	0	67	0	0	58	25	67	0	0	0	8	0
151-200	0	0	0	0	9	0	0	0	0	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Viburnum trilobum Marsh.

See colour plate

Family	:	Caprifoliaceae
English name	:	American cranberrybush
French name	:	Viorne trilobée, pimbina (western and central Quebec)
Category	:	Deciduous plant
Subdivision	:	Medium-sized tree

BOTANICAL DESCRIPTION

This indigenous shrub or small tree, with an erect growth habit and rounded crown, is vigorous and can attain a height of 5 m.

The opposite and simple leaves are composed of three wide, ovate lobes and are 5 to 12 cm long. They are rounded or truncated at the base, coarsely serrate and glossy. They are dark green on the upper surface and turn red in the fall.

Flowering occurs in the spring. The fertile white flowers, grouped in umbels 5 to 7 cm in diameter, are surrounded by 2 cm sterile flowers. They bloom from the periphery toward the centre. After pollination, the ring of sterile flowers withers and falls off.

The edible fruits ripen in early fall and are bright red. They remain on the branches for much of the winter. They are very acidic and therefore do not attract birds.

ORIGIN AND DISTRIBUTION

This indigenous species is found in western and central Quebec, New Brunswick, British Columbia and in southern New York State, Michigan, Dakota and Oregon. This species is very close to the European species *V. opulus* and is sometimes considered a variety called *americanum*. The fruit is called a "pimbina," a word of Indian origin.

USE

Ornamental: This shrub is very easy to grow and can be used as a hedge. This species is appreciated for its flowering in late spring, for its fruits and for the fall colours of its foliage. In order to ensure its pollination, it is advisable to group plants known for their fruit production in two or threes.

Culinary: The fruits are harvested when the fall frosts have made them translucent. If they are gathered before this time, they are hung in small bundles in a cold room. The effect of the cold transforms the mesocarp, making it juicier.

Medical: The bark is used in the preparation of medicines.

REQUIREMENTS

This species prefers a sunny exposure but also tolerates slight shade. Almost all well-drained soils are suited to it and it tolerates drier soils.

PATHOLOGY

To our knowledge, no serious disease appears to affect this species.

PROPAGATION

Propagation by cuttings: Softwood cuttings take root easily and this method of propagation is recommended.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 393 cuttings of 15 cm were taken on June 29, 1984 and treated with a solution of 4,000 ppm IBA. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 100% after four weeks. Potting was carried out on July 25 and 30 and August 9. The cuttings were placed in a frame on July 31 and August 4 and 16. They overwintered in an open frame under a thick cover of snow. The survival rate was 96%. The plants were shipped on May 7, 1985.



Inclusion in test network: Young plants 7 to 8 cm high were planted at nine test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1985 to 1990.

RESULTS (1985-1990)

In general, very little mortality was observed on this species. Mild frost damage on the shoot tips was observed at all the sites except Sainte-Clotilde. Mechanical breakage occurred at three of the nine test sites.

Winter damage

Region 1

In this region, only one plant died at Sainte-Anne-de-Bellevue the last year.

No damage was observed at Sainte-Clotilde and only one plant suffered mechanical breakage at the L'Assomption site on clay.

At L'Assomption on sand, nearly half the plants suffered light frost damage on the shoot tips the fourth year and all the plants at Sainte-Anne-de-Bellevue suffered this type of damage the last winter.

Region 2

Two plants died in this region following the first winter, one plant at Deschambault and another at La Pocatière. Frost damage on the stem tips occurred three winters out of five at the three sites in this region.

Nearly half the plants at Deschambault were affected by mechanical breakage during the last winter.

Region 3

Three plants died following the second winter at Normandin. In addition, at this site, 67% of the plants suffered frost damage on the stem tips the second and third winters.

At Kapuskasing, more severe frost damage occasionally occurred: 40% of the plants suffered frost damage down to the level of snow cover the last winter and 20% suffered mechanical breakage. In addition, 25% of them were affected on the previous year's shoot the first

winter. In general, 40% to 100% of the plants suffered frost damage on the stem tips four winters out of five.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.83 m R2 = 1.23 m R3 = 1.04 m

After five years, the plants in region 1 were clearly higher than those in the other regions.

Categories

The average height of the shrubs after five years varied from one site to another:

2.01 m and + : Sainte-Anne-de-Bellevue
 1.76 - 2.00 m: Sainte-Clotilde and L'Assomption on sand
 1.51 - 1.75 m: -
 1.26 - 1.50 m: Sainte-Foy, L'Assomption on clay and La Pocatière
 1.01 - 1.25 m: Normandin and Deschambault
 1.00 m and - : Kapuskasing

The plants at Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand were clearly taller than those at the other sites by the second year.

Effect of pruning

This species required very little pruning.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.58 m R2 = 1.20 m R3 = 0.89 m

The plants in region 1 were clearly wider than those in the other regions.



Viburnum trilobum Marsh.

Categories

The average width of the shrubs after five years varied from one site to another:

- 1.51 - 1.75 m: Sainte-Anne-de-Bellevue, Sainte-Clotilde and L'Assomption on sand
- 1.26 - 1.50 m: Sainte-Foy and L'Assomption on clay
- 1.01 - 1.25 m: La Pocatière and Deschambault
- 1.00 m and - : Normandin and Kapuskasing

Flowering

In region 1, the flowering period began between May 25 and 30, depending on the year and the site. The total duration of flowering was 15 to 30 days and the peak flowering period was 15 to 20 days, depending on the site.

In region 2, flowering began between June 1 and 5, i.e. approximately six days later. The total duration of flowering was 25 to 30 days with a peak flowering period of 12 to 16 days.

In region 3, flowering began some 15 days later than in region 1; the first flowers appeared between June 8 and 13, depending on the year. The total flowering period lasted 16 to 17 days and was most attractive during the last 9 or 10 days.

Flowering was more abundant during the last two or three years of testing, as the plants approached their adult state.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

The production of this species is very rapid. By the second year, at the end of the season, 76%, 86%, 89% and 100% of the plants at Sainte-Clotilde, L'Assomption on sand, Sainte-Anne-de-Bellevue and Sainte-Foy had

attained a height of between 51 and 100 cm. A third year was necessary for the plants at all the other sites to attain this height.

The production of this species is competitive in the initial years throughout Quebec. To obtain more developed plants, region 1 is favoured since growth there was greater in the fourth and fifth seasons.

Use

The more frequent damage observed at Kapuskasing is indicative of the probable use and hardiness limit for this species. The zone rating of 2 assigned by Sherk and Buckley could be revised or identified more precisely as 2a, since Kapuskasing is at the limit of zones 2a and 1b.

Under colder climatic conditions, *Viburnum trilobum* has significantly slower growth in height and in width without, however, losing its ornamental features.

BIBLIOGRAPHICAL REFERENCES

3, 21, 27, 34, 47, 56, 60, 65, 71, 86, 88

WRITTEN BY

Claude Richer, Agr.
Jacques-André Rioux, Agr.
Jacques Côté, Biol.



Table 1: Frequency of winter damage observed on *Viburnum trilobum* from 1985 to 1990

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11		
REGION 1											
L'Assomption-clay	98							2		2	
L'Assomption-sand	92	8								8	
Ste-Anne-de-Bellevue	76	22				2				24	
Sainte-Clotilde	100									0	
REGION 2											
Deschambault	44	44				1		11		56	
Sainte-Foy	84	16								16	
La Pocatière	93	5	1			1				7	
REGION 3											
Normandin	70	27				3				30	
Kapusking	29	54	5	8				4		71	

- ^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 splitting |
| 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, 5, 7, 9 and 11 occurred for this species.

Table 2: Breakdown of *Viburnum trilobum* plants by marketable height category from 1985 to 1989

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue									
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89					
0-25	90	0	0	0	0	83	0	0	0	0	43	0	0	0	0	80	0	0	0	0					
26-50	10	14	0	0	0	17	61	0	0	0	57	24	0	0	0	20	11	0	0	0					
51-75	0	67	8	0	0	0	39	42	0	0	0	71	8	0	0	0	68	8	0	0					
76-100	0	19	33	0	0	0	0	58	67	8	0	5	42	0	0	0	16	15	0	0					
101-150	0	0	59	100	0	0	0	0	33	67	0	0	50	58	0	0	5	77	42	0					
151-200	0	0	0	0	83	0	0	0	0	25	0	0	0	42	75	0	0	0	58	25					
201 and +	0	0	0	0	17	-	-	-	-	-	0	0	0	0	25	0	0	0	0	75					
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusking				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-25	67	0	0	0	0	100	20	0	0	0	100	0	0	0	0	95	6	0	0	0	100	57	0	0	0
26-50	33	0	0	0	0	0	63	17	0	0	0	100	33	0	0	5	33	8	0	0	0	43	20	0	0
51-75	0	57	0	0	0	0	15	66	8	0	0	0	67	8	0	0	55	25	8	0	0	0	20	60	10
76-100	0	43	42	17	0	0	0	17	67	58	0	0	0	42	0	0	6	67	50	17	0	0	60	40	50
101-150	0	0	58	78	92	0	0	0	25	42	0	0	0	50	100	0	0	0	42	83	0	0	0	0	40
151-200	0	0	0	5	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Table 3: Breakdown of *Viburnum trilobum* plants by marketable width category from 1985 to 1989

Width (cm)	REGION 1																			
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde					Sainte-Anne-de-Bellevue				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	52	0	0	0	0	28	0	0	0	0	NA	0	0	0	0	NA	NA	NA	0	0
21-40	48	10	0	0	0	66	44	0	0	0	NA	0	0	0	0	NA	NA	NA	0	0
41-60	0	42	0	0	0	6	56	8	8	0	NA	24	0	0	0	NA	NA	NA	0	0
61-100	0	48	92	25	0	0	0	84	75	17	NA	76	67	0	0	NA	NA	NA	0	0
101-140	0	0	8	67	0	0	0	8	17	66	NA	0	33	67	0	NA	NA	NA	50	17
141-160	0	0	0	0	42	0	0	0	0	17	NA	0	0	33	25	NA	NA	NA	50	8
161 and +	0	0	0	8	58	-	-	-	-	-	NA	0	0	0	75	NA	NA	NA	0	75

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusasing				
	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89	85	86	87	88	89
0-20	43	0	0	0	0	NA	15	0	0	0	NA	0	0	0	0	NA	17	0	0	0	100	29	22	0	0
21-40	57	0	0	0	0	NA	65	0	0	0	NA	47	0	0	0	NA	44	0	0	0	0	57	33	0	0
41-60	0	48	0	0	0	NA	20	50	17	0	NA	53	75	0	0	NA	39	25	8	0	0	7	45	70	0
61-100	0	52	58	8	0	NA	0	50	83	58	NA	0	25	75	0	NA	0	37	92	75	0	7	0	30	90
101-140	0	0	42	92	50	NA	0	0	0	42	NA	0	0	25	92	NA	0	38	0	25	0	0	0	0	10
141-160	0	0	0	0	50	NA	-	-	-	-	NA	0	0	0	8	NA	-	-	-	-	-	-	-	-	-
161 and +	-	-	-	-	-	NA	-	-	-	-	NA	-	-	-	-	NA	-	-	-	-	-	-	-	-	-



Weigela florida 'Variegata'

See colour plate

Family	:	Caprifoliaceae
English name	:	Variegata old fashioned weigela
French name	:	Diervillé panaché
Synonym	:	<i>Weigela rosea</i> 'Nana Variegata'

BOTANICAL DESCRIPTION

This shrub, with a compact growth habit, can attain a height of 1.5 to 3.0 m, although frost damage rarely allows it to attain this height in Quebec.

The young branches are thin, numerous, arched and spreading. Their colour varies from brownish-grey to dark brown.

The foliage is variegated and the colour of the leaf margin varies from pale yellow to creamy white. The leaves, which are opposite, simple, elliptic to ovate, wide, acuminate and rounded at the base, are 5 to 10 cm long and glabrous. The petiole is short. Leafing occurs in late spring.

The pale pink flowers are in clusters of three or four. They are bell-shaped and the inside of the tube is paler. They form on the old wood. Flowering is recurrent, but the pale colour of the flowers blends in with that of the foliage.

ORIGIN AND DISTRIBUTION

The *florida* species is originally from Korea or northern China and was discovered around 1844.

USE

Ornamental: This cultivar can be used in clumps or standing alone for its flowering and the colours of its foliage.

REQUIREMENTS

This cultivar, like the type species, prefers sunny exposures but adapts to semi-shady conditions; the colours of the foliage will then be faded. It adapts to several soil types.

PATHOLOGY

No serious disease appears to affect this cultivar.

PROPAGATION

Propagation by cuttings: Propagation of this cultivar by cuttings is considered easy and cuttings can be taken throughout the summer.

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Roger-Van den Hende Garden, Sainte-Foy, Quebec

Propagation site: Laval University, Sainte-Foy, Quebec

Propagation technique: 575 cuttings of approximately 10 cm were taken on August 5, 1983 and dipped for four seconds in a solution of 4,000 ppm IBA and 50% ethanol, then rinsed in tap water. They were immersed in a fungicidal solution containing Benomyl-Captan[®]. They were placed in a mist propagator in a substrate composed of peat (40%) and perlite (60%). The rooting rate was 100% after 27 days. Potting was carried out on September 1 in Fertile Pots[®] in a substrate composed of peat (60%) and perlite (40%). The pots were buried in the sand of a cold frame on September 10. The cuttings overwintered in the frame under a thick cover of snow and the winter survival rate was 77%; 264 plants were transplanted to the nursery in May 1984 and the recovery rate was 100%. In May 1985, they were cut back to 2 cm from the ground. The winter survival rate in the nursery was 100%. They were dug up on April 28, 1986, puddled, wrapped and placed in a cold store at 4°C, then shipped a few days later.

Inclusion in test network: Young plants 15 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.



RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, all the plants were affected by winter damage. This damage included frost damage on the stem tips the first winter, frost damage on the previous year's shoot the second winter, a mix of both types of damage the following winter and frost damage on the majority of the plants down to the level of snow cover the last two winters.

Results were similar at the L'Assomption site on clay, with the addition of plants that suffered frost damage down to the ground level and one plant that died during the fourth winter.

At Sainte-Clotilde, 33% and 82% of the plants did not suffer any damage during the first and last winters and the other plants suffered frost damage on the stem tips or on the old wood. During the second winter, all the plants suffered frost damage down to the ground level. The following winter, they all exhibited frost damage on the previous year's shoot and, the fourth winter, they suffered frost damage down to the level of snow cover and one plant died.

Region 2

As at Sainte-Clotilde, some plants at Sainte-Foy suffered no frost damage during the last winter. All the plants suffered frost damage down to the level of snow cover the second, third and fourth winters, and frost damage on the stem tips was evident the first and last winters on 81% and 42% of the plants.

At Deschambault, the plants suffered frost damage every year. All the plants were affected down to the level of snow cover the second winter and 75% of the plants were damaged on the stem tips the following winter. The fourth winter, 33% and 67% of the plants were affected by frost damage on the previous year's shoot and on the old wood, and the last winter, 67% and 33% suffered frost damage on the stem tips and on the previous year's shoot.

At La Pocatière, all the plants died during testing: 5% the first winter, 25% the second winter, 10% of those that remained the fourth winter and all the others the last winter. The pedological conditions were responsible for this gradual mortality since the frost damage observed on

the living plants was limited to frost damage on the stem tips the first four winters and frost damage on the old wood the first two winters.

Region 3

At Normandin, 50% of the plants died the first winter, 10% of the remaining plants the following winter and 15% the fourth winter. Frost damage on the stem tips was the main damage the second winter. Most of the plants suffered frost damage on the previous year's shoot during the first, third and fifth winters and 86% of the plants suffered frost damage down to the ground level the fourth winter.

At Kapuskasing, all the plants died during the first four winters and the plants that survived the first three winters regularly suffered frost damage down to the ground level.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 0.82 m R2 = 0.98 m R3 = 0.53 m

At several sites, the maximum height was attained by the end of the third or fourth year of growth.

Categories

The average height of the shrubs after five years varied from one station to another:

1.01 m and + : Deschambault
0.76 - 1.00 m: L'Assomption on sand, Sainte-Foy, Sainte-Clotilde and La Pocatière
0.51 - 0.75 m: L'Assomption on clay and Normandin
0.50 m and - : Kapuskasing

The height of the plants was lower at the sites with clay soil.

Effect of pruning

Pruning resulted in a reduction of the previous year's shoot of approximately 30% to 90% and the extent of pruning was attributable to the severity of winter damage.

***Weigela florida* 'Variegata'**

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.15 m R2 = 1.24 m R3 = 0.55 m

At the sites in region 1, width was greater by the end of the fourth year of growth and it is this average which is provided here. At Deschambault, La Pocatière, Normandin and Kapuskasing, width increased every year.

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.51 m and + : Deschambault
- 1.26 - 1.50 m: L'Assomption on sand and Sainte-Clotilde
- 1.01 - 1.25 m: Sainte-Foy and La Pocatière
- 0.76 - 1.00 m: L'Assomption on clay
- 0.75 m and - : Normandin and Kapuskasing

The highest and widest plants were at Deschambault at the end of the testing period.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

After two growing seasons, almost all the plants at L'Assomption on sand, Sainte-Clotilde, Sainte-Foy and Deschambault had attained a height of between 51 cm and 100 cm. This sector, where the zone rating is 4b to 5, is therefore preferred for production. In zone 2, damage was too severe to recommend production there.

Use

In all the regions, this cultivar exhibited very severe frost damage but plant mortality was observed in zone 2 only.

The zone rating of 5 assigned by Buckley appears to be overestimated in terms of the cold resistance of this cultivar. However, it can survive the climatic conditions in zone 4, although the severe frost damage requires that the plant be cut back one year out of two or three and limits its flowering. Nonetheless, the colours of the foliage remain consistently attractive. That is why this cultivar can be assigned two ratings, one higher than 5b for its cold resistance and a rating of 4 for its survival and possible use.

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4, 13, 27, 49, 50, 102

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Table 1: Frequency of winter damage observed on *Weigela florida* 'Variegata' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	0	40	20	26	12	2					100
L'Assomption-sand	7	33	33	27							93
Sainte-Clotilde	23	13	20	18	20	2	4				77
REGION 2											
Deschambault	0	35	17	25				17	4	2	100
Sainte-Foy	10	25		61	4						90
La Pocatière	0	55	8			28	9				100
REGION 3											
Normandin	0	32	38		17	13					100
Kapuskasing	0	3			58	39					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 splitting |
| 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 types 3 and 14 occurred for this species.

Table 2: Breakdown of *Weigela florida* 'Variegata' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	76	5	0	0	8	81	38	25	0	0	76	0	0	0	9										
51-100	24	95	42	0	58	19	62	75	100	100	24	100	100	42	91										
101-150	0	0	58	83	34	-	-	-	-	-	0	0	0	58	0										
151-200	0	0	0	17	0	-	-	-	-	-	-	-	-	-	-										
Height (cm)	REGION 2															REGION 3									
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	67	0	0	0	0	70	0	0	0	0	100	95	56	55	13	100	100	43	14	17	100	100	90	100	100
51-100	33	100	75	50	83	30	100	100	25	0	0	5	44	33	50	0	0	57	86	83	0	0	10	0	0
101-150	0	0	25	50	17	0	0	0	75	100	0	0	0	12	37	-	-	-	-	-	-	-	-	-	-
151-200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Weigela florida* 'Variegata' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	86	0	0	0	8	67	10	0	0	27	38	0	0	0	0
51-100	14	5	25	0	33	33	90	92	75	63	62	0	25	0	27
101-150	0	95	75	83	59	0	0	8	25	10	0	100	75	100	73
151-200	0	0	0	17	0	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	76	0	0	0	0	30	0	0	0	0	100	75	33	44	12	100	75	14	14	0	100	100	90	67	100
51-100	24	67	33	25	33	70	95	75	50	0	0	25	33	12	38	0	25	86	86	100	0	0	10	33	0
101-150	0	33	67	75	67	0	5	25	50	58	0	0	34	44	50	-	-	-	-	-	-	-	-	-	-
151-200	-	-	-	-	-	0	0	0	0	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Weigela hybrida 'Bristol Ruby'

The sections Botanical Description, Origin and Distribution, Use, Requirements, Pathology, Propagation and Bibliographical References were published previously in the first series of descriptive reports (publication 02-9227).

PROPAGATION CARRIED OUT BY REPLOQ

Origin of parent plant: Montreal Botanical Garden, Montreal, Quebec

Propagation site: Montreal Botanical Garden, Montreal, Quebec

Propagation technique: Cuttings were taken on June 20, 1984. They were treated with a solution of 4,000 ppm IBA and placed in a mist propagator in a substrate of perlite. The plants were potted during the summer and placed in frames where they overwintered, protected by the frames and panels. They were shipped in the spring of 1986.

Inclusion in test network: Young plants 25 cm high were planted at eight test sites distributed across Quebec and northeastern Ontario (Table 1). Their winter survival and growth potential were evaluated from 1986 to 1991.

RESULTS (1986-1991)

Winter damage

Region 1

At the L'Assomption site on sand, frost damage was more severe the last three winters, affecting 67% of the plants on the old wood and 50% and 67% of the plants above the level of snow cover. In addition, frost damage on the stem tips and on the year's shoot was apparent on almost all the other plants.

At the site on clay, damage on the stems exposed above the level of snow cover occurred one winter out of two on 75% to 100% of the plants. The second and fourth winters, the most frequently observed type of damage was frost damage on the previous year's shoot or frost

damage on the stem tips. At Sainte-Clotilde, the plants suffered frost damage on the stem tips the first winter, but did not suffer any damage the last winter. During the other winters, the plants suffered frost damage down to the ground level or on the above-ground portion exceeding the level of snow cover.

Region 2

At Sainte-Foy, frost damage on the stem tips was observed three winters out of five. The second winter, the plants suffered frost damage on the previous year's shoot. The third winter, a third of the plants suffered frost damage on the old wood, another third suffered frost damage down to the level of snow cover and the last third suffered damage caused by rodents.

At Deschambault, frost damage down to the level of snow cover and on the previous year's shoot occurred the second, third and fourth winters.

All the plants died at La Pocatière because of the poor pedological conditions of this plot.

Region 3

At Normandin, with a few exceptions, all the plants suffered frost damage on the previous year's shoot and occasionally down to the level of snow cover or to the ground level.

At Kapuskasing, some plants died every year. Of the plants still living, 67% suffered frost damage on the previous year's shoot the third winter and all the others suffered frost damage down to the ground level.

Growth in height

After five years, the average height of the shrubs for each region was:

R1 = 1.37 m R2 = 1.55 m R3 = 0.80 m

Annual growth was always significant, given the severity of the annual pruning.



Categories

The average height of the shrubs after five years varied from one station to another:

- 1.51 m and + : Sainte-Foy and Sainte-Clotilde
- 1.26 - 1.50 m: Deschambault and L'Assomption on sand
- 1.25 m and - : L'Assomption on clay, Normandin and Kapuskasing

Effect of pruning

Pruning was very extensive and the plants were severely cut back every year, eliminating 50% to 60% of the wood.

Growth in width

After five years, the average width of the shrubs for each region was:

R1 = 1.31 m R2 = 1.52 m R3 = 1.43 m

The plants were as wide as they were high at the sites in regions 1 and 2. They were wider than high in region 3.

Categories

The average width of the shrubs after five years varied from one station to another:

- 1.76 m and + : Sainte-Foy and Deschambault
- 1.51 - 1.75 m: Sainte-Clotilde
- 1.01 - 1.50 m: L'Assomption on sand, L'Assomption on clay, Normandin and Kapuskasing

Flowering

In region 1, flowering began between June 1 and 10, depending on the year. The first flowering lasted on average 20 to 30 days. A second, less abundant flowering occurred occasionally. In region 2, the first flowers appeared between June 12 and 26, i.e. 10 to 16 days later. The duration of flowering was similar to region 1. At the sites in region 3, flowering occurred in July and August, which coincided with the second flowering in the other regions; in this region, flowering was sporadic, less abundant and formed on the new shoots.

RECOMMENDATIONS

Tables 2 and 3 indicate the percentage of marketable plants 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 the annual production as well as the number of years necessary to obtain a predetermined height or width.

Production

At the L'Assomption on sand, Sainte-Clotilde, Sainte-Foy and Deschambault sites, 90% or more of the plants had attained a height of more than 1.00 m after two years of growth. Subsequently, the difference between the sites became less pronounced because of the severity of the spring pruning. It is therefore preferable to produce this cultivar in zones 5 or 4b, where growth is greater, under protected conditions.

Use

This test confirmed the results obtained with the plants evaluated from 1984 to 1989. The test again demonstrated that the zoning established by Sherk and Buckley (zone 5) is overestimated since the plants at the sites in region 1 (zones 5a and 5b) all suffered fairly serious damage every year. This cultivar can survive in regions where the climatic conditions are harsher, provided that they are protected by a thick cover of snow very early in the fall. However, flowering is likely to be less abundant as a result of the severity of spring pruning.

This cultivar can be assigned three different ratings: a rating higher than 5 for its cold resistance, a rating of 2b for its survival at protected sites and a rating of 4b for its use at protected sites.

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Table 1: Frequency of winter damage observed on *Weigela hybrida* 'Bristol Ruby' from 1986 to 1991

Test site	No damage	Percentage breakdown of damage									Cumulative damage
		WINTER DAMAGE ^a									
	1	2	4	6	7	8	5 and 9	10	11	14	
REGION 1											
L'Assomption-clay	0	18	18	58		1			5		100
L'Assomption-sand	7	37	20	23				13			93
Sainte-Clotilde	20	20		33	20			7			80
REGION 2											
Deschambault	0	25	42	25					8		100
Sainte-Foy	2	52	20	7				6		13	98
La Pocatière	0					100					100
REGION 3											
Normandin	0	13	60	7	20						100
Kapuskasing	0		13		75	12					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 splitting |
| 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 types 5 and 14 occurred for this species.

Table 2: Breakdown of *Weigela hybrida* 'Bristol Ruby' plants by marketable height category from 1986 to 1990

Height (cm)	REGION 1																								
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde														
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90										
0-50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
51-100	100	0	0	0	0	100	100	82	100	0	100	0	0	0	0										
101-150	0	100	92	58	75	0	0	18	0	100	0	100	100	50	67										
151-200	0	0	8	42	25	-	-	-	-	-	0	0	0	50	33										
Height (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapuskasing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	0	0	0	0	0	95	83	40	40	0	14	0	0	0	0	100	30	0	25	17
51-100	100	5	0	0	0	100	10	17	0	0	5	17	60	60	75	86	76	83	50	75	0	70	100	75	83
101-150	0	95	100	100	58	0	90	83	58	0	0	0	0	25	0	24	17	50	25	-	-	-	-	-	-
151-200	0	0	0	0	42	0	0	0	42	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3: Breakdown of *Weigela hybrida* 'Bristol Ruby' plants by marketable width category from 1986 to 1990

Width (cm)	REGION 1														
	L'Assomption on sand					L'Assomption on clay					Sainte-Clotilde				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51-100	100	10	17	0	17	100	100	100	100	27	100	0	0	0	0
101-150	0	90	83	92	58	0	0	0	0	73	0	100	100	100	58
151-200	0	0	0	8	25	-	-	-	-	-	0	0	0	0	42
201 and +	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Width (cm)	REGION 2										REGION 3														
	Sainte-Foy					Deschambault					La Pocatière					Normandin					Kapusksing				
	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90	86	87	88	89	90
0-50	5	0	0	0	0	10	0	0	0	0	95	89	20	40	0	43	0	0	0	0	100	35	11	25	17
51-100	95	0	0	0	0	90	100	42	50	0	5	11	80	60	50	57	10	42	75	42	0	65	89	63	83
101-150	0	100	50	75	0	0	0	58	50	17	0	0	0	0	50	0	90	58	25	58	0	0	0	12	0
151-200	0	0	50	25	92	0	0	0	0	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201 and +	0	0	0	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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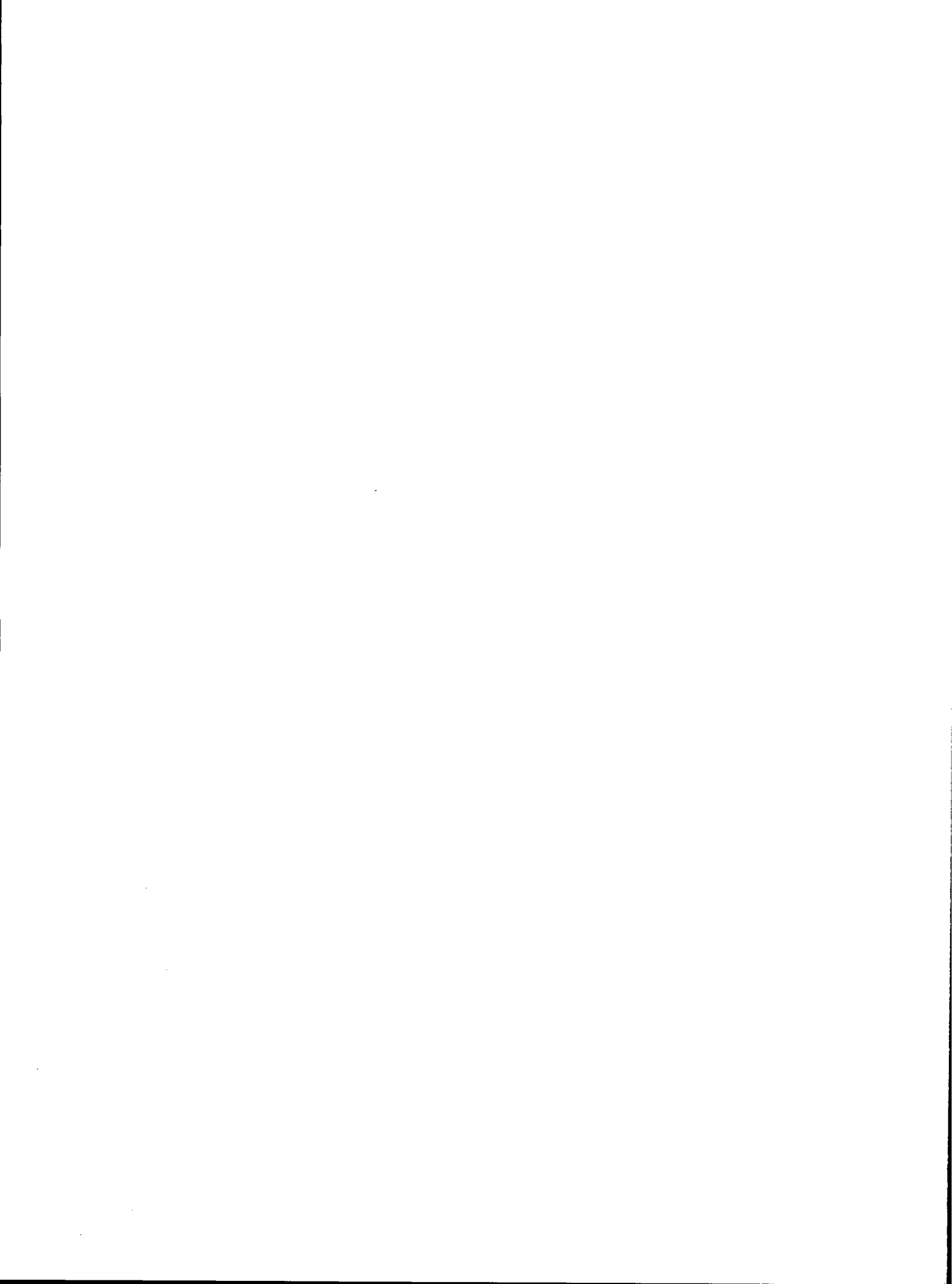
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