Boreal Plant Species for Reclamation of Athabasca Oil Sands Disturbances – Updated December 2014

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Wild Rose Consulting Inc.

December, 2013

Oil Sands Research and Information Network

The Oil Sands Research and Information Network (OSRIN) is a university-based, independent organization that compiles, interprets and analyses available knowledge about managing the environmental impacts to landscapes and water impacted by oil sands mining and gets that knowledge into the hands of those who can use it to drive breakthrough improvements in regulations and practices. OSRIN is a project of the University of Alberta's School of Energy and the Environment (SEE). OSRIN was launched with a start-up grant of $4.5 million from Alberta Environment and a $250,000 grant from the Canada School of Energy and Environment Ltd.

OSRIN provides:

- **Governments** with the independent, objective, and credible information and analysis required to put appropriate regulatory and policy frameworks in place
- **Media, opinion leaders and the general public** with the facts about oil sands development, its environmental and social impacts, and landscape/water reclamation activities – so that public dialogue and policy is informed by solid evidence
- **Industry** with ready access to an integrated view of research that will help them make and execute environmental management plans – a view that crosses disciplines and organizational boundaries

OSRIN recognizes that much research has been done in these areas by a variety of players over 40 years of oil sands development. OSRIN synthesizes this collective knowledge and presents it in a form that allows others to use it to solve pressing problems.

Citation

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Copies of this report may be obtained from OSRIN at osrin@ualberta.ca or through the OSRIN website at http://www.osrin.ualberta.ca/en/OSRINPublications.aspx or directly from the University of Alberta's Education & Research Archive at http://hdl.handle.net/10402/era.17507.

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Oil sands reclamation guidance documents prepared by the Cumulative Environmental Management Association and endorsed by the provincial government include lists of potential reclamation species and their characteristics (Alberta Environment 2008, 2010). This report consolidates and updates profiles for 100 of these species.

Each profile contains the following information (where applicable):

- Species Nomenclature – up-to-date scientific names and widely used common names along with plant family designations; common names should be used with caution as many distinct species have the same or similar common names and common names may vary by region
- Plant Description
  - Fruit
  - Seed
- Habitat and Distribution of the species locally and worldwide
  - Seral Stage
  - Soil
  - Distribution based on Moss (1983) unless otherwise noted. Moss uses the following convention to describe distribution:
    The North American distribution is generally given in two tiers from west to east across the continent. The first tier represents the northern limit, the second tier the southern limit. A comma indicates a reasonably continuous distribution and a semi-colon indicates a disjunction.
- Phenology – particularly based on observations from north eastern Alberta
- Pollination mechanisms are described if known.
- Genetic Information (ploidy)
- Known Symbioses
- Seed Processing
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- Propagation – including seed and vegetative propagation
    - Natural Regeneration
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- Aboriginal/Food Uses
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- Wildlife/Forage Usage
- Reclamation Potential – with examples from oil sands reclamation studies where available
- Commercial Resources
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    - Uses (other than the Aboriginal uses noted above)
- Notes – including comments on alternative names (genera and species names change with increasing knowledge of biology and genetics; caution should be used when consulting older references such as Budd and Best (1969) and Moss (1983) because of potential name changes since these were published)

Each profile is illustrated with photographs of the plant, flowers, fruit and/or seeds if available and line drawings are also included if available (Budd and Best (1969) is an excellent source for line drawings). References for the content are provided with each profile.

Although the original objective for the profiles was to inform decisions made by reclamation planners and practitioners in the oil sands and to promote the inclusion of these species in revegetation, the information has a much wider audience appeal. We continue to be inundated with requests for all types of species information from professionals in other industries as well as provincial, municipal and federal government agencies, nursery producers, aboriginal groups, researchers, archeologists, cultural anthropologists and ethno-botanists, wildlife biologists, foresters, range managers, horticulturalists, naturalists and the general public. At the November 25, 2013 OSRIN workshop *Future of Shrubs in Oil Sands Reclamation* participants noted a lack

of awareness of, and in for many species the need for, the types of information contained in these species profiles.

This report is a valuable tool for those directly responsible for planning and executing reclamation in the oil sands as well as for other professionals involved in native plant work.

ACKNOWLEDGEMENTS

The Oil Sands Research and Information Network (OSRIN), School of Energy and the Environment (SEE), University of Alberta provided funding for this project.

OSRIN and Wild Rose Consulting Inc. are grateful to the Canadian Oil Sands Network for Research and Development (CONRAD) Environment and Reclamation Research Group (ERRG), the individual oil sands companies and Alberta Environment, Oil Sands and Clean Energy Branch, who provided initial funding for Wild Rose to undertake the work to prepare the species profiles and who provided permission to use the information in this report. The companies who provided funding and permission to use the materials are shown below.

1 INTRODUCTION

Oil sands reclamation guidance documents prepared by the Cumulative Environmental Management Association and endorsed by the provincial government include lists of potential reclamation species and their characteristics (Alberta Environment 2008, 2010). This report consolidates and updates profiles for 100 of these species.

Profiles for individual species are provided on OSRIN's website at http://www.osrin.ualberta.ca/Resources/RevegSpeciesProfiles.aspx and on the University of Alberta's Education & Research Archive site at http://hdl.handle.net/10402/era.36891. **Updates to species profiles were made periodically on the ERA site and have now been consolidated in this revised version.**

Since 1994, Wild Rose Consulting Inc. (WRC) has been involved with several projects to examine propagation, nursery production and field establishment of many native upland boreal plant species on landscapes disturbed by oil sands development. Results from these studies and trials have been (and continue to be) compiled with other published information into individual species 'profiles'. Profiles for the initial 20 boreal species were submitted to CONRAD and included in the latest iteration of the *Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region* (Alberta Environment 2010). A further 40 were submitted (to CONRAD and/or ASRD) for inclusion in upcoming iterations of the Revegetation Manual. Further, WRC continues to accumulate information as it becomes available and as we support various groups and industry with planning reclamation.

Although the original objective for the profiles was to inform decisions made by reclamation planners and practitioners in the oil sands and to promote the inclusion of these species in revegetation, the information has a much wider audience appeal. We continue to be inundated with requests for all types of species information from professionals in other industries as well as provincial, municipal and federal government agencies, nursery producers, aboriginal groups, researchers, archeologists, cultural anthropologists and ethno-botanists, wildlife biologists, foresters, range managers, horticulturalists, naturalists and the general public. At the November 25, 2013 OSRIN workshop *Future of Shrubs in Oil Sands Reclamation* participants noted a lack of awareness of, and in for many species the need for, the types of information contained in these species profiles.

This report is a valuable tool for those directly responsible for planning and executing reclamation in the oil sands as well as for other professionals involved in native plant work.

1.1 Species List and Funding for Development of the Species Profiles

Table 1 lists the species profiled in this report and the organizations that provided funding for development of content for each of the species profiles.

Table 1. Species List and Funding Providers for Species Profile Content.

Scientific Name	Common Name	Family	CONRAD	AENV	OSRIN
Achillea millefolium	common yarrow	Asteraceae	✓		✓
Acorus americanus	rat root, sweet flag, calamus	Araceae	✓		
Actaea rubra	baneberry	Ranunculaceae	✓		✓
Alnus incana ssp. tenuifolia	river alder, thin leaf alder, speckled alder, gray alder	Betulaceae	✓		
Alnus viridis ssp. crispa	green alder, sitka alder, mountain alder, wavy-leaf alder, slide alder	Betulaceae	✓		
Amelanchier alnifolia	saskatoon, service berry, June berry, shadbush, shadblow, indian pear, may cherry	Rosaceae	✓	✓	
Anemone canadensis	Canada anemone, meadow anemone	Ranunculaceae	✓		
Anemone multifida	cut-leaf anemone, globe anemone	Ranunculaceae	✓	✓	
Anemone patens	prairie crocus, crocus anemone, pasqueflower	Ranunculaceae	✓	✓	
Anthoxanthum nitens	sweetgrass, vanilla grass, holy grass	Poaceae	✓		
Apocynum androsaemifolium	spreading dogbane, bitterroot, flytrap, Indian hemp	Apocynaceae	✓	✓	
Aralia nudicaulis	wild sarsaparilla	Araliaceae	✓		
Arctostaphylos uva-ursi	bearberry, kinnikinnick, red bearberry, cowberry, manzanita, mealberry	Ericaceae	✓	✓	
Astragalus agrestis	cock's-head, field milkvetch, purple milkvetch	Fabaceae			✓
Astragalus alpinus	alpine milkvetch	Fabaceae	✓		✓
Astragalus americanus	American milk vetch, rattlepod	Fabaceae	✓		✓
Astragalus canadensis	Canadian milkvetch, Canada milk-vetch	Fabaceae	✓		✓
Betula nana	bog birch, arctic dwarf birch, swamp birch	Betulaceae	✓		
Betula papyrifera	paper birch, western birch, white birch, canoe birch	Betulaceae	✓		
Bromus ciliatus	fringed bromegrass	Poaceae	✓	✓	
Calamagrostis stricta	boreal reed grass, northern reed grass, slimstem reedgrass	Poaceae	✓		

Scientific Name	Common Name	Family	CONRAD	AENV	OSRIN
Campanula rotundifolia	bluebell, bluebell-of-Scotland, harebell, roundleaf harebell	Campanulaceae	✓	☐	☐
Castilleja miniata	common red paintbrush, giant red Indian paintbrush, scarlet paintbrush	Scrophulariaceae	✓	☐	✓
Castilleja raupii	purple paintbrush, Raup's Indian paintbrush	Scrophulariaceae	✓	☐	☐
Chamerion angustifolium	fireweed, great willow-herb	Onagraceae	✓	☐	✓
Comandra umbellata	bastard toadflax, pale comandra	Santalaceae	☐	☐	✓
Cornus canadensis	bunchberry, bunchberry dogwood, creeping dogwood, pigeonberry	Cornaceae	✓	✓	☐
Cornus sericea ssp. sericea	red-osier dogwood, dogwood, red willow	Cornaceae	✓	☐	☐
Corydalis aurea	golden corydalis, golden smoke, scrambled eggs	Fumariaceae	✓	☐	✓
Corylus cornuta	beaked hazel, beaked hazelnut, western hazel, wild filbert, beaked filbert	Betulaceae	✓	☐	☐
Cypripedium acaule	moccasin flower, pink lady's slipper, pink lady's-slipper orchid, pink moccasin flower, stemless lady's slipper	Orchidaceae	✓	☐	☐
Dasiphora fruticosa	shrubby cinquefoil	Rosaceae	✓	✓	☐
Deschampsia caespitosa	tufted hair grass, tussock grass	Poaceae	✓	☐	☐
Draba nemorosa	woodland draba	Brassicaceae	✓	☐	✓
Drosera rotundifolia	round-leaved sundew	Droseraceae	✓	☐	✓
Eleocharis acicularis	needle spike rush, needle spike sedge	Cyperaceae	✓	☐	☐
Eleocharis palustris	creeping spikerush, common spikerush, spike sedge	Cyperaceae	✓	☐	☐
Fragaria virginiana ssp. glauca	wild strawberry, Virginia strawberry	Rosaceae	✓	✓	☐
Galium boreale	northern bedstraw, sweet scented bedstraw, fragrant bedstraw	Rubiaceae	✓	☐	✓
Geranium bicknellii	Bicknell's geranium, Bicknell's cranesbill	Geraniaceae	✓	☐	✓
Geum rivale	purple avens, water avens, chocolate-root	Rosaceae	✓	☐	✓
Hedysarum alpinum	alpine sweetvetch, alpine sweet broom, licorice root, sweetbroom	Fabaceae	✓	☐	✓

Scientific Name	Common Name	Family	CONRAD	AENV	OSRIN
Hedysarum boreale	boreal sweet-vetch, boreal sweetvetch, northern sweetvetch, sweetvetch	Fabaceae	✓	☐	☐
Heracleum sphondylium ssp. Montanum	common cow parsnip, cow parsnip	Apiaceae	✓	☐	☐
Hesperostipa curtiseta	western porcupine grass, Canadian needle grass, shortbristle needle and thread	Poaceae	✓	✓	☐
Hudsonia tomentosa	beach heather, woolly beach-heather, sand golden-heather	Cistaceae	✓	☐	✓
Juniperus communis	common juniper, ground juniper, dwarf juniper, low juniper	Cupressaceae	✓	☐	☐
Larix laricina	tamarack, Alaskan larch, American larch, eastern larch, hackmatack	Pinaceae	✓	☐	☐
Lathyrus ochroleucus	cream pea, creamy peavine, pale vetchling peavine	Fabaceae	✓	☐	☐
Leymus innovatus	hairy wildrye, fuzzyspike wildrye, boreal wildrye	Poaceae	✓	☐	✓
Lilium philadelphicum	tiger lily, wood lily, prairie lily, wild lily, red lily, western red lily	Liliaceae	✓	☐	☐
Linnaea borealis	northern twinflower	Caprifoliaceae	✓	☐	✓
Lonicera caerulea	blue fly honeysuckle, mountain fly honeysuckle, sweetberry honeysuckle, honeyberry	Caprifoliaceae	✓	✓	☐
Lonicera dioica var. glaucescens	twining honeysuckle, limber honeysuckle	Caprifoliaceae	✓	☐	✓
Lonicera involucrata	bracted honeysuckle, black twinberry, swamp honeysuckle	Caprfoliaceae	✓	☐	✓
Maianthemum canadense	wild lily-of-the-valley, false lily-of-the-valley, Canada mayflower	Asparagaceae	✓	☐	☐
Melampyrum lineare	cow-wheat, narrowleaf cow-wheat	Orobanchaceae	☐	☐	✓
Mentha arvensis	wild mint, field mint	Lamiaceae	✓	☐	☐
Mertensia paniculata	bluebell, tall lungwort, tall bluebell	Boraginaceae	✓	☐	✓
Mitella nuda	bishop's cap, bare-stem bishop's-cap, miterwort, naked miterwort	Saxifragaceae	✓	☐	☐
Oxytropis splendens	showy crazyweed, showy locoweed, showy pointvetch	Fabaceae	✓	☐	✓

Scientific Name	Common Name	Family	CONRAD	AENV	OSRIN
Phragmites australis	reed grass, common reed grass, giant reed grass, carrizo	Poaceae	✓	☐	✓
Picea glauca	white spruce, Canadian spruce, cat spruce	Pinaceae	✓	☐	✓
Pinus banksiana	jack pine	Pinaceae	✓	☐	✓
Populus balsamifera	balsam poplar, black poplar	Salicaceae	✓	☐	✓
Populus tremuloides	trembling aspen, quaking aspen, aspen poplar, white poplar	Salicaceae	✓	☐	✓
Primula pauciflora var. pauciflora	saline shooting star, darkthroat shooting star	Primulaceae	✓	☐	☐
Prunus pensylvanica	pin cherry, fire cherry, wild red cherry, pigeon cherry, bird cherry	Rosaceae	✓	✓	☐
Prunus virginiana	chokecherry, common chokecherry, Virginia chokecherry	Rosaceae	✓	☐	☐
Pyrola asarifolia	common pink wintergreen, liverleaf wintergreen, shinleaf wintergreen, pink pyrola	Ericaceae	✓	☐	✓
Rhododendron groenlandicum	Labrador tea, bog Labrador tea, rusty Labrador-tea, St. James' tea, marsh tea, swamp tea, Hudson's Bay tea	Ericaceae	✓	☐	☐
Ribes glandulosum	skunk currant, skunk red currant, skunkberry, fetid currant	Grossulariaceae	✓	☐	☐
Ribes hudsonianum	northern black currant, black currant, Hudson Bay currant	Grossulariaceae	✓	☐	✓
Ribes lacustre	bristly black currant, prickly currant, swamp currant	Rosaceae	✓	☐	✓
Ribes triste	swamp red currant, red currant	Grossulariaceae	✓	☐	☐
Rosa acicularis	prickly rose, bristly rose	Rosaceae	✓	☐	☐
Rubus arcticus ssp. acaulis	dwarf raspberry, arctic blackberry, arctic bramble	Rosaceae	✓	☐	✓
Rubus chamaemorus	cloud berry, bake-apple, baked-apple berry	Rosaceae	✓	☐	✓
Rubus idaeus	red raspberry	Rosaceae	✓	✓	☐
Rubus pubescens	dewberry, trailing raspberry, running raspberry	Rosaceae	✓	☐	✓
Rumex aquaticus	western dock	Polygonacaeae	✓	✓	☐
Salix bebbiana	Bebb's willow, gray willow	Salicaceae	✓	☐	☐

Scientific Name	Common Name	Family	CONRAD	AENV	OSRIN
Salix exigua	sand bar willow, coyote willow, narrow leaf willow, desert willow	Salicaceae	✓	☐	☐
Salix lucida	greenleaf willow, Pacific willow, shining willow	Salicaceae	✓	☐	☐
Schizachne purpurascens	false melic, false melic grass, purple oat grass	Poacaeae	✓	☐	☐
Scirpus microcarpus	small-fruited bulrush, panicled bullrush, barber-pole bulrush	Cyperaceae	✓	☐	☐
Shepherdia canadensis	buffaloberry, Canadian buffaloberry, soapberry, russet buffaloberry, soopalalie	Elaeagnaceae	✓	✓	☐
Sibbaldiopsis tridentata	three-toothed cinquefoil, shrubby five fingers	Rosaceae	✓	☐	☐
Sisyrinchium montanum	mountain blue-eyed grass, strict blue-eyed grass	Iridaceae	☐	☐	✓
Solidago canadensis	Canada goldenrod, common goldenrod	Asteraceae	✓	✓	☐
Solidago simplex var. spathulata	mountain goldenrod, spike-like goldenrod, sticky goldenrod	Asteraceae	✓	✓	☐
Symphoricarpos albus	snowberry, common snowberry, white coralberry	Caprifoliaceae	✓	☐	☐
Symphyotrichum laeve	smooth aster, smooth blue aster, purple aster	Asteraceae	✓	☐	☐
Symphyotrichum puniceum var. puniceum	purple stem aster	Asteraceae	✓	☐	☐
Trientalis borealis	northern starflower	Primulaceae	✓	✓	☐
Vaccinium myrtilloides	blueberry, velvet-leaf blueberry, Canada blueberry, velvet-leaf huckleberry	Ericaceae	✓	☐	☐
Vaccinium oxycoccos	small bog cranberry	Ericaceae	✓	☐	✓
Vaccinium vitis-idaea	bog cranberry, cowberry, lingonberry, mountain cranberry, partridgeberry, northern mountain cranberry, lowbush cranberry	Ericaceae	✓	☐	☐
Viburnum edule	lowbush cranberry, mooseberry, squashberry, squawberry, crampbark, pembina	Caprifoliaceae	✓	✓	☐
Vicia americana	peavine, wild pea, American vetch, wild vetch	Fabaceae	✓	✓	☐

1.2 Report Structure

The species profiles are organized in four sections: trees, shrubs, grasses and grass-like species, and forbs. At the start of each section a table lists the species covered in that section.

Readers may jump to a species profile using the Bookmarks feature in the .pdf document (found on the left hand side of the document).

Readers should note that the pages for the profiled species are **not** numbered.

Each profile contains the following information (where applicable):

- Species Nomenclature – up-to-date scientific names and widely used common names along with plant family designations; common names should be used with caution as many distinct species have the same or similar common names and common names may vary by region
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- Phenology – particularly based on observations from north eastern Alberta
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- Genetic Information (ploidy)
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- Seed Processing
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  - Seed / Fruit Weight (see Table 2 for a summary)
  - Harvest Dates
  - Cleaning

    - Storage Behaviour
    - Storage
    - Longevity
- Propagation – including seed and vegetative propagation
    - Natural Regeneration
    - Germination
    - Pre-treatments (see Table 3 for a summary)
    - Vegetative Propagation
- Greenhouse timelines for seedling production
- Aboriginal/Food Uses
    - Food
    - Medicinal
    - Other
- Wildlife/Forage Usage
- Reclamation Potential – with examples from oil sands reclamation studies where available
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- Notes – including comments on alternative names (genera and species names change with increasing knowledge of biology and genetics; caution should be used when consulting older references such as Budd and Best (1969) and Moss (1983) because of potential name changes since these were published)

Each profile is illustrated with photographs of the plant, flowers, fruit and/or seeds if available and line drawings are also included if available (Budd and Best (1969) is an excellent source for line drawings). References for the content are provided with each profile.

Table 2. Seed and Fruit Metrics.

Species	**Average Seeds/g**	**g/1,000 Seeds**	**Average Seeds/Fruit**	**Average # of Fruit/L**	**Average # of Fruit/kg**
Achillea millefolium	*6,250 to 8,333*	0.12 to 0.16			
Acorus americanus	*1,084 to 1,901*	0.526 to 0.922			
Actaea rubra	*175*	5.7			
Alnus incana ssp. Tenuifolia	2,013	0.51			
Alnus viridis ssp. Crispa	5,582	0.1996			
Amelanchier alnifolia	334	3.02	9	1,590	3,350
Anemone canadensis	*571*	1.75			
Anemone multifida	1,152	0.95			
Anemone patens	1,136	1.08			
Anthoxanthum nitens	*833 to 2,439*	0.41 to 1.2			
Apocynum androsaemifolium	6,295	0.16			
Aralia nudicaulis	198	0.90	5	3,320	5,650
Arctostaphylos uva-ursi	168	6.31	6	1,690	3,720
Astragalus agrestis	260	3.84			
Astragalus alpinus	476 to 588	1.7 to 2.1			
Astragalus americanus	*943*	1.06			
Astragalus canadensis	600	1.67			
Betula nana	272	0.83 to 3.68			
Betula papyrifera	6,375	0.17			
Bromus ciliatus	306 to 547	0.33 to 1.75			

Species	**Average Seeds/g**	**g/1,000 Seeds**	**Average Seeds/Fruit**	**Average # of Fruit/L**	**Average # of Fruit/kg**
Calamagrostis stricta	*4,500 to 31,250*	0.032 to 0.22			
Campanula rotundifolia	31,810	0.03			
Castilleja miniata					
Castilleja raupii	13,970	0.07			
Cornus canadensis	151	6.65	1	2,780	7,890
Cornus sericea ssp. Sericea	38	26.71	1	2,460	4,900
Corydalis aurea	*917*	1.09			
Corylus cornuta	1.2	833			
Cypripedium acaule	*333,333*	0.0030	14,000 to 54,000		
Dasiphora fruticosa	5,353	0.20			
Deschampsia caespitosa	*1,111 to* 5,510	0.5 to 0.9			
Draba nemorosa	*33,333*	0.03			
Drosera rotundifolia	*50,000*	0.02			
Eleocharis acicularis	*22,727*	0.044			
Eleocharis palustris	*1,315*	0.76			
Fragaria virginiana ssp. Glauca	2,598	0.39	35	2,370	3,940
Galium boreale	2,469	0.405 to 0.6			
Geranium bicknellii	*543*	1.84			
Geum rivale	880	1.01	100 to 150		
Hedysarum alpinum	200 *to 229*	4.35			

Species	**Average Seeds/g**	**g/1,000 Seeds**	**Average Seeds/Fruit**	**Average # of Fruit/L**	**Average # of Fruit/kg**
Hedysarum boreale	70 to 260	4.35 to 5.8			
Heracleum sphondylium ssp. *Montanum*	105	6.0 to 14.6			
Hesperostipa curtiseta	81	12.38			
Hudsonia tomentosa	*416*	2.4			
Juniperus communis	80	23.3	1 to 3		
Larix laricina	*500 to 699*	1.43 to 2			
Lathyrus ochroleucus	*60*	16.4			
Leymus innovatus	*55* to 392	18			
Lilium philadelphicum	1,340	1.21			
Linnaea borealis	*699*	2	1		
Lonicera caerulea	1,900	0.54	10	2,450	4,350
Lonicera dioica var. *glaucescens*	20	50			
Lonicera involucrata	720	1.33 to 1.39			
Maianthemum canadense	111	9.05	1.3	8,370	14,700
Melampyrum lineare	*414*	2.414	1 to 4		
Mentha arvensis	*9,433 to 10,101*	0.099 to 0.106			
Mertensia paniculata					
Mitella nuda	3,606	0.28			
Oxytropis splendens	770	1.3			
Phragmites australis	*9,090*	0.11			

Species	**Average Seeds/g**	**g/1,000 Seeds**	**Average Seeds/Fruit**	**Average # of Fruit/L**	**Average # of Fruit/kg**
Picea glauca	*6,250 to 8,333*	0.12 to 0.16			
Pinus banksiana	*288*	3.47			
Populus balsamifera	*4,166*	0.24			
Populus tremuloides	*10,000*	0.1			
Primula pauciflora var. *pauciflora*	*4,166*	0.24			
Prunus pensylvanica	26	39.64	1	1,620	3,310
Prunus virginiana	15	69.67	1	1,200	2,090
Pyrola asarifolia	*142,857*	0.007			
Rhododendron groenlandicum	53,230	0.03			
Ribes glandulosum	*1,149*	0.87	14		
Ribes hudsonianum	*1,369 to 2,127*	0.47 to 0.73			
Ribes lacustre	*1,041 to 1,136*	0.88 to 0.96			
Ribes triste	*312*	3.2			
Rosa acicularis	104	9.88	23	630	1,130
Rubus arcticus ssp. *Acaulis*	*454 to 591*	1.69 to 2.2	25		
Rubus idaeus	1,243	1.23	37	808	1,160
Rubus pubescens					
Rumex aquaticus	1,096	0.95			
Salix bebbiana	*5,500*	0.1818			
Salix exigua	*22,026*	0.0454			

Species	**Average Seeds/g**	**g/1,000 Seeds**	**Average Seeds/Fruit**	**Average # of Fruit/L**	**Average # of Fruit/kg**
Salix lucida	*5,780 to 25,316*	0.0395 to 0.173	12 to 20		
Schizachne purpurascens	591	1.70			
Scirpus microcarpus	*6,250 to 16,666*	0.06 to 0.16			
Shepherdia canadensis	165	6.13	1	5,640	8,090
Sibbaldiopsis tridentata	2,611	0.39			
Sisyrinchium montanum	*1,234*	0.81			
Solidago canadensis	11,740	0.11			
Solidago simplex var. *spathulata*	10,020	0.13			
Symphoricarpos albus	208	4.89	2	3 220	10,000
Symphyotrichum laeve	5,048	0.20			
Symphyotrichum puniceum var. *puniceum*	*4,347 to 7,142*	0.14 to 0.23			
Trientalis borealis	2,269	0.45			
Vaccinium myrtilloides	6,810	0.15	37	2,540	5,240
Vaccinium oxycoccos	*1,018 to 1,666*	0.6 to 0.982	8		
Vaccinium vitis-idaea	4,880	0.21	12	3,190	7,050
Viburnum edule	46	22.07	1	1,770	3,030
Vicia americana	60 to 77	13.13			

NOTE: *italicized values* in the Average Seeds/g are calculated based on the g/1,000 Seeds values taken from the literature. As such they should be taken as an estimate only.

1.3 Species Ranking Systems

In addition to the descriptions of various plant attributes contained in the references cited in the species profiles some authors and sites have ranked various species characteristics and tolerances (Table 3).

Table 3. Ranking Systems for Various Species Characteristics and Tolerances.

	Hardy BBT Limited 1989	Howat 2000	Alberta Environment 2008	Plants of the North	Geographic Dynamics Corp. 2002	Inkpen and Van Eyk, n.d.	Tannas 1997 - 2004	Gerling et al. 1996	Wroe et al., 2003	Northern Bushcraft n.d.	Plants for a Future	Hiltz et al. 2012
Salinity	√	√	√									
pH	√	√	√		√							
SAR		√										
Drought	√				√							
Hardiness	√			√								
Persistence	√											
Nitrogen Fixing					√							
Erosion Control	√				√							
Wildlife value	√				√	√	√					
Grazing response / forage value							√	√	√			
Compete / Resist Competition					√							
Successional Stage					√							

	Hardy BBT Limited 1989	Howat 2000	Alberta Environment 2008	Plants of the North	Geographic Dynamics Corp. 2002	Inkpen and Van Eyk, n.d.	Tannas 1997 - 2004	Gerling et al. 1996	Wroe et al., 2003	Northern Bushcraft n.d.	Plants for a Future	Hiltz et al. 2012
Flooding / Water Table			√		√							
Moisture Regime												√
Edibility (human)										√	√	
Medicinal value										√	√	

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3 GLOSSARY

3.1 Terms

Achene

A small, dry 1-seeded indehiscent fruit (Moss 1983).

Adventitious

Roots or stems which develop in an unusual or irregular position (Moss 1983).

Antiemetic

An antiemetic inhibits vomiting (and nausea).

Apomixis

Replacement of the normal sexual reproduction by asexual reproduction, without fertilization.

Aristate

Having a bristle or awn (Moss 1983).

Auricles

Ear-shaped appendages/lobes (Moss 1983).

Caryopsis

A grain, as of grasses; a seed-like fruit (Moss 1983).

Coriaceous

Leathery texture (Moss 1983).

Crenate

With rounded teeth, scalloped (Moss 1983).

Dark Septate

Fungi with a dark septum dividing cells.

Decoction

The extraction of the water-soluble substances of a drug or medicinal plants by boiling.

Dioecious

Unisexual with male and female flowers/cones on separate plants (Moss 1983).

Ectomycorrhizal

Associations with a hyphal mantle enclosing short lateral roots and a Hartig net of labyrinthine hyphae that penetrate between root cells (Brundrett 2008).

Emetic

A substance that induces vomiting when administered orally or by injection.

Endomycorrhizal

A mycorrhizal association where the hyphae live within the root, typical of the hair roots of ericoid species (Brundrett 2008).

Endotrophic Tolypophagus Mycorrhizae

A type of endomycorrhizae that digests plant tissues from within the root/root hair.

Epigeal Germination

Above-ground germination. The seed is pushed out of the soil prior to cotyledon emergence. Hypogeal germination is the reverse, where the seed remains in the ground and cotyledons break

through soil. http://upload.wikimedia.org/wikipedia/commons/thumb/2/20/Germination-en.svg/335px-Germination-en.svg.png

Facultative

Optional or discretionary. In the case of succession, these species are associated with many stages.

Galea

A hood-like part of a perianth or corolla; the upper lip of some corolloas (Moss 1983).

Hammer Mill

Used to disintegrate the product to desired size.
http://pimg.tradeindia.com/00529369/b/2/Hammer-Mill.jpg

Hartig net

Labyrinthine hyphae that penetrate between root cells, forming a net-like matrix (Brundrett 2008). http://mycorrhizas.info/ecm/pine-hartig1.jpg

Hermetic

Airtight. In common usage, the term often implies being impervious to air or gas.

Infusion

The steeping or soaking, usually in water, of a substance (e.g., a plant or plant part) to extract its soluble constituents.

Layering

A portion of an aerial stem grows roots while still attached to the parent plant and then detaches as an independent plant.

Lenticles

Small dots or spots on the bark of young twigs in many shrubs and trees (Moss 1983).

Monoecious

Having male and female flowers/cones on the same plant (Moss 1983).

Organogenesis

The process by which the callus cells develop into an explant via micropropagation.

Orthodox

Seeds can be dried, without damage, to low moisture contents, usually much lower than those they would normally achieve in nature. Over a wide range of storage environments their longevity increases with reductions in both moisture content and temperature, in a quantifiable and predictable way.

Samara

A dry, indehiscent, winged fruit (Moss 1983).

Scalping (seed)

Removing large trash, stems, leaves, and associated chaff prior to basic cleaning. http://reveg-catalog.tamu.edu/images/12-Seed-Proc/01-Crippen%20scalper.JPG

Scarification

Etching or notching a seed coat via mechanical or chemical treatments to promote germination.

Seed Drill

A sowing device that precisely positions seeds in the soil and then covers them. http://upload.wikimedia.org/wikipedia/commons/thumb/4/4c/Sowing_machine_Nordsten.jpg/300px-Sowing_machine_Nordsten.jpg

Slash

Coarse and fine woody debris generated during logging operations or through wind, snow or other natural forest disturbances.

Stratification

The process of pretreating seeds to simulate natural conditions required for germination, most often a cold period.

Vesicular-Arbuscular Mycorrhizae (VAM)

Glomeromycete fungi produce arbuscules, hyphae, and vesicles within root cortex cells (Brundrett 2008). Note: Some Glomeromycetes produce only arbuscules (AM)

Winnow

To free (grain) from the lighter particles of chaff, dirt, etc., especially by throwing it into the air and allowing the wind or a forced air current to blow away impurities.

3.2 Acronyms

ASRD	Alberta Sustainable Resource Development (now part of Alberta Environment and Sustainable Resource Development)
CONRAD	Canadian Oil Sands Network for Research and Development
ERRG	Environment and Reclamation Research Group (CONRAD)
GA	Gibberellic Acid
IAA	Indole Acetic Acid

IBA	Indole Butric Acid
IPGRI	International Plant Genetic Resources Institute
ITIS	International Taxonomic Information System
NRCS	Natural Resources Conservation Service
OSRIN	Oil Sands Research and Information Network
SEE	School of Energy and the Environment
sp.	Species (singular)
spp.	Species (plural)
ssp.	Sub-species
USDA	US Department of Agriculture
WRC	Wild Rose Consulting Inc.

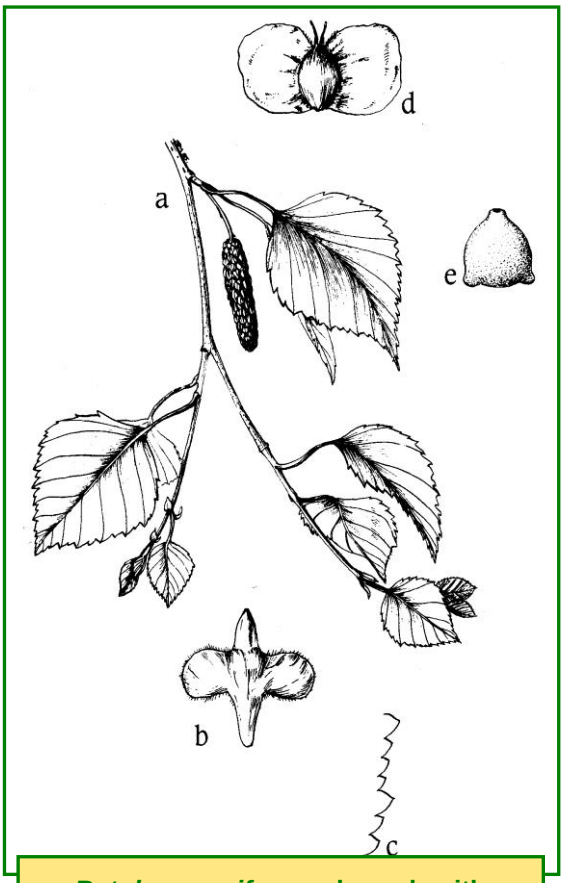
APPENDIX 1: Trees

The following tree species are profiled in this Appendix.

Scientific Name	Common Name	Family
Betula papyrifera	paper birch, western birch, white birch, canoe birch	Betulaceae
Larix laricina	tamarack, Alaskan larch, American larch, eastern larch, hackmatack	Pinaceae
Picea glauca	white spruce, Canadian spruce, cat spruce	Pinaceae
Pinus banksiana	jack pine	Pinaceae
Populus balsamifera	balsam poplar, black poplar	Salicaceae
Populus tremuloides	trembling aspen, quaking aspen, aspen poplar, white poplar	Salicaceae

Scientific Name: *Betula papyrifera* Marsh. **Family:** *Betulaceae*

Common Names: paper birch, western birch, white birch, canoe birch



***Betula papyrifera*. a. branch with leaves and seed catkin. b. cone bract. c. leaf margin. d. seed. e. pollen.**

Plant Description

Perennial tree, up to 30 m high; trunk to 60 cm diameter, bark white to red-brown, brown lenticels, peeling in sheets; dark brown branches with fuzzy twigs; oval to diamond-shaped leaves, 4 to 9 cm, toothed, fuzzy beneath, tufts of hair on vein axils; catkins, 2 to 3 cm (Moss 1983). Relatively short-lived: 80 to 120 years (CYSIP: Botany n.d., Government of the Northwest Territories n.d.).

Fruit: Pendulous aments paired on spur shoots (Moss 1983).

Seed: Samaras, 3 per bract; flat, oblong, membranous winged nutlets, 2.5 to 3.5 mm x 1.5 to 2 mm (4 to 5 mm with wings), ridged, brown.

Habitat and Distribution

Co-dominant in mixed woods with *Populus tremuloides, Picea mariana, Picea glauca, Pinus banksiana,* and *Abies balsamifera*. Prefers north or east facing slopes. Paper birch is shade intolerant and has high drought tolerance (Hardy BBT 1989).

Seral Stage: Can form pioneer stands on disturbed sites in boreal systems. (Hardy BBT 1989).

***Betula papyrifera* often becomes a multi-stemmed tree.**

Soil: Grows on a variety of soil types, but best on well-drained deep, sandy or silty soils. Can tolerate moderate acidic soils to as low as pH 3.2 (Hardy BBT 1989). Paper birch tolerates flood and drought and has a moderate salinity tolerance (Gerling et al. 1996).
Distribution: In Alberta, found in mountains, widespread across boreal forest and occasional in parkland; Alaska, Yukon, southwestern District of Mackenzie, northern Saskatchewan, central Manitoba, Great Lakes to Labrador south to Washington, Montana, Colorado, northern Nebraska, Minnesota, New York, Pennsylvania (Moss 1983). Widespread in central and northern Alberta forming pure stands on burned or cutover areas (Hardy BBT 1989).

Phenology

Female plants mature around 15 years (Government of the Northwest Territories n.d.). Flowers in mid-April to early June, seeds mature in August and September. Seeds disperse from August through the following spring (Young and Young 1992).

Pollination

Pollinated by wind.

Seed Dispersal

Seed is dispersed by wind.

Genetics

2n=56, 84 (Moss 1983).

Symbiosis

Ectomycorrhizal (Hagerman and Durall 2004). Birch trees may also serve as refuge for multi- and late-stage fungi (Kranabetter 1999).

Seed Processing

Collection: Catkins are easily stripped from branches. Pole-pruners or felling are necessary to harvest from tall trees.

Seed Weight: 0.090 to 0.175 g/1,000 seeds (0.152 average).
Harvest Dates: Late July to September in northeastern Alberta. Ripe catkins will be green or yellow to brown in colour (Banerjee et al. 2001). Collect August 1 to September 15 (Formaniuk 2013).
Cleaning: Air-dry fruits/cones at 15 to 25°C. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens (8/64 inch screen size) (Young and Young 1992).
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store at cool temperatures (2 to 5°C) at 1% to 3% moisture (Young and Young 1992). Hermetic storage at temperatures of -25°C to 3°C with 1% to 3% moisture content recommended for long-term storage by (Royal Botanic Gardens Kew 2008).
Longevity: Seed can remain viable up to 3 years (Smreciu et al. 2002). Safford et al. (1990) suggest that storage up to 8 years is possible when stored in sealed containers at 2 to 4°C at low moisture.

Emerging seedling of *Betula papyrifera*.

Propagation

Natural Regeneration: Establishes itself from seed (Hardy BBT 1989) and suckers (Tannas 1997). Seeds that disperse in late fall and winter exhibit

higher germination capacity than seeds dispersed early (Safford et al. 1990).

Germination: >60% germination following 30 days cold stratification with fresh seeds of subspecies *neoalaskensis* (Smreciu et al. 2002).

Seeds lose viability quickly. Seed germination and conditions are shown to vary depending on where the seed was collected (Baskin and Baskin 2001).

Seed germinated at 25°C (Baskin and Baskin 2001).

Pre-treatment: Four weeks cold stratification before seeding (Wood pers. comm.); 60 to 90 days cold stratification (Formaniuk 2013, Nichols 1934).

Can germinate in the presence or in the absence of light, but light increases the success rate of seed germination (Baskin and Baskin 2001, Brunvatne 1998, Young and Young 1992).

If tested under light at 20 to 25°C, no pre-treatment necessary for germination (Brinkman 1974). Seeds germinated at 25°C (Baskin and Baskin 2001).

Direct Seeding: 0.06% emergence the first year to 0.09% by year 4 with resulting robust seedlings. Best germination occurs on mineral soil under 45% sunlight (Safford et al. 1990).

Seed Rate: 200 seeds/m² results in approximately 1 plant/m².

Vegetative Propagation: Reproduces from suckers (Uchytil 1991) and by regeneration from stump base and root collar.

Fifteen to 24 cm long nodal cuttings with a long shallow wound may root if treated with 2,000 to 8,000 ppm IBA-solution before planting in a peat:sand medium (Dirr and Heuser 1987).

Paper birch can also be propagated by grafting and layering (Babb 1959).

Micro-propagation: Shoot tip culture, extraction of axillary bud from young stem segments (Dirr and Heuser 1987).

Greenhouse Timeline: 16 weeks in the greenhouse before out-planting. Plants can be over wintered for a spring or early fall plant (Wood pers. comm.).

Grow for 120 days prior to harvest (Formaniuk 2013).

Emerging seedling of *Betula papyrifera*.

Aboriginal/Food Uses

Food: The inner bark can be eaten as a sweet treat and starvation food; leaves, inner bark and root inner bark can be boiled to make a beverage; sap can be drunk or boiled down to make syrup (CYSIP: Botany n.d., Marles et al. 2000) or a light beer (Royer and Dickinson 1996).

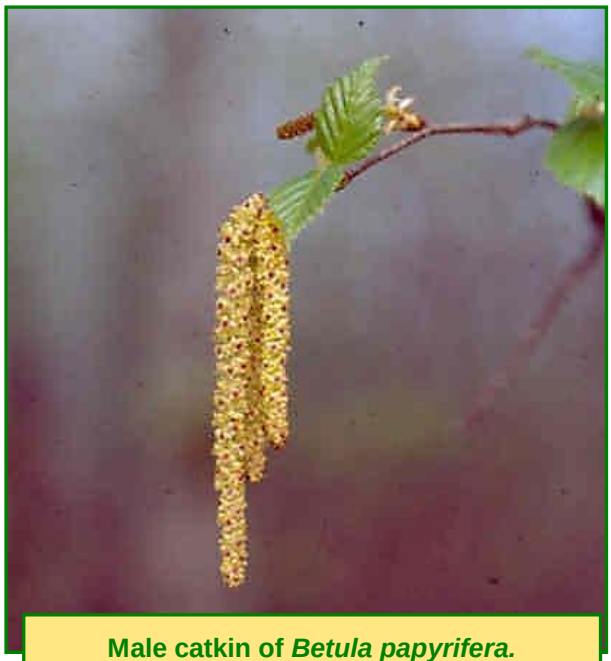
Medicinal: Leaves can be used as wasp sting plaster; birch bark can be boiled and used in a decoction to enhance fertility; bark can be applied as a poultice for aching bones; powdery outer layer can be sprinkled on a sprained ankle; a sleeve of bark can become a cast for an arm or leg; a piece of sweet bark can relieve teething; the bark, as part of a compound decoction, can be drunk to treat tuberculosis and other lung problems; the reddish inner bark tea can be used as a gargle, for sore throats and colds; buds mixed with lard makes an ointment for treating skin sores and infections; roots can be used in a decoction to relieve menstrual cramps (Marles et al. 2000).

Roots or buds could be boiled to make a wash for the eyes of people afflicted by snow blindness (CYSIP: Botany n.d.).

Oil in the bark contains methylsalicylate and a poultice of the boiled bark was used to treat bruises, wounds and burns (Wilkinson 1990).

Other: Sheets of bark can be made into baskets, bowls, tube to call moose, canoes, tepee covers, writing/drawing materials, weaving shuttles, artwork drum frames, handles, ceremonial rattles and

kindling; wood used to make spoons, bows, sleds, snowshoe frames, canoe paddle, arrows,; inner bark can be made into yellow-red dye; birch branches are used to make sweat lodge frames (Government of the Northwest Territories n.d., Marles et al. 2000, Wilkinson 1990).
Rotting wood is considered good for smoking skins (CYSIP: Botany n.d.).
Cree made a body powder from an extract of rotten wood and Labrador tea (Royer and Dickinson 1996).



Male catkin of ***Betula papyrifera.***

Wildlife/Forage Usage

Wildlife: Paper birch is browsed by moose and white-tailed deer and is an important component of their diet. Snowshoe hares feed on saplings and porcupines eat inner bark. Small mammals (voles and shrews) and birds (CYSIP: Botany n.d.) feed on catkins, seeds (redpoll, pine siskin, and chickadee), and buds. Sapsuckers favour paper birch sap leading to use by hummingbirds and squirrels. Ruffed grouse eat male catkins and buds (Safford et al. 1990).
Birch stands also provide habitat for all types of wildlife (Uchytil 1991).
Livestock: Moderately palatable and used by livestock mostly in winter and spring (Tannas 1997).
Grazing Response: Tolerant of moderate to heavy grazing (Uchytil 1991).

Reclamation Potential

This fast growing, aggressive pioneer species rapidly colonizes open sites following disturbances (wildfire, wind throw, avalanche) and is recommended as an early successional species (Tannas 1997). Paper birch is a prime hardwood species for revegetation of disturbed sites. The litter formed by this species contributes to the nutrient content of the forest floor (enriched with calcium, potassium, magnesium, phosphorus and boron) (Safford et al. 1990).
Betula papyrifera produces an abundance of lightweight seeds that are easily dispersed by wind, and in the case of a wildfire, the fire-prepared seedbeds make for rapid seedling establishment. However, paper birch seedlings have poor survival and dieback in the first 5 years after major disturbances (e.g., mining). After only one generation, it will be replaced by shade tolerant conifers or northern hardwoods (Uchytil 1991).

Commercial Resources

Availability: Available commercially in various stages (seed, saplings) at Alberta and Saskatchewan nurseries.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: At least two cultivars are available in the horticultural trade but these are unsuitable for revegetation use.
Uses: Birch wood is valued in the fabrication of veneer, plywood and pulpwood. The treetops are used for interior decorating, and the branches are used for decorative furniture, baskets, wreaths, birdcages and other decorative purposes.

The essential oil is used in aromatherapy. Birch bark contains betulin, an antiviral drug against the AIDS virus and betulinic acid against melanoma and brain tumors (Marles et al. 2000).

Notes

Betula papyrifera is listed as 93% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Betula papyrifera is short-lived. It ceases to grow in height at 60 to 70 years old. Most trees do not live more than 140 years.

Because of their canopy's high moisture content and their lush understory, paper birch stands are one of the least flammable forest types (Uchytil 1991).

Although Hardy BBT (1989) indicates that paper birch is deep rooted, Safford et al. (1990) found that their root network is mostly found in the top 60 cm of soil and does not form taproots.

Stressed plants are subject to attack by the bronze birch borer (*Agrilus anxius* Gory)(Cerezke 1994), three species of birch leaf miners (*Fenusa pusilla* Lepeletier, *Profenusa thomsonii* Konow and *Heterarthrus nemoratus* Fallen)(Wong et al. 1991), and in some cases by the large aspen tortrix (*Choristoneura conflictana* (Walker) when they are epidemic(Cerezke 1992).

Photo Credits

Photos 1, 3, 4: Wild Rose Consulting, Inc.
Photo 2: Steve Hurst @ USDA plants 2012.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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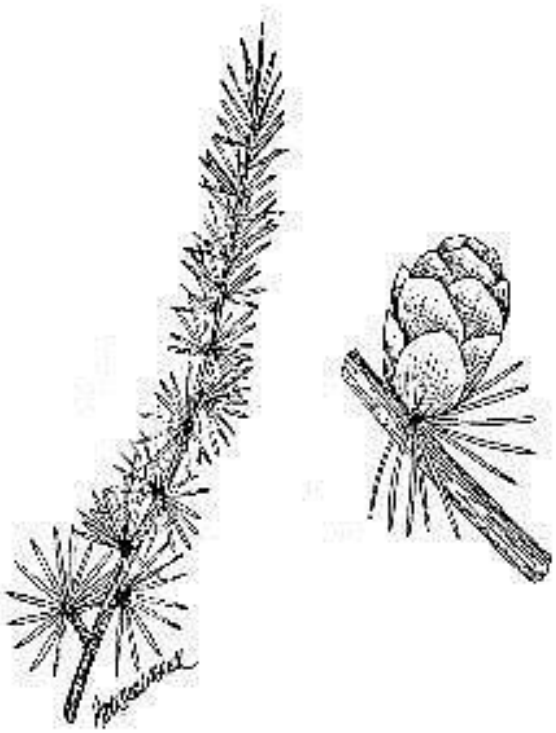
Scientific Name: *Larix laricina* (Du Roi) K. Koch **Family:** *Pinaceae*

Common Name: tamarack, Alaskan larch, American larch, eastern larch, hackmatack



***Larix laricina* needles and cones.**

Plant Description

Deciduous monoecious tree, up to 20 m tall; straight trunk 10 to 25 cm diameter, thin, reddish brown bark with small, rough scales; leaves soft and needle-like in clusters of 12 to 20, 1 to 2.5 cm long, deciduous (turn yellow as fall in autumn) (Moss 1983). Plants live to 150 years (Government of the Northwest Territories n.d.).

Fruit: Brown seed cones (reddish when young, becoming brown when mature – Inkpen and Van Eyk n.d.) ovoid, 1 to 2.5 cm long, rounded scales (Moss 1983, Royer and Dickinson 2007). Two seeds produced per scale.

Seed: Light brown, winged on one side, 3 to 4 mm long and 2 to 3 mm wide.

Habitat and Distribution

Common in muskeg, swamps, fens and other poorly drained sites (Inkpen and Van Eyk n.d., Johnson et al. 1995, Moss 1983) but grows best on drier, well drained sites; shade intolerant (USDA NRCS n.d.).

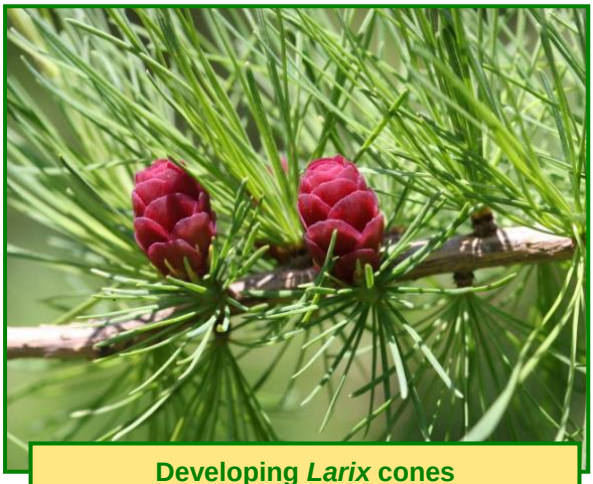
Seral Stage: Early.

Soil: Medium to coarse textured mineral soils with pH between 5.5 and 6.5 (Johnson et al. 1995, USDA NRCS n.d.).

Not tolerant of saline soils (USDA NRCS n.d.). Renault (2005) tested tolerance to two levels of NaCl and found that seedlings had moderate tolerance to salinity.

Distribution: Widespread in boreal regions (Johnson et al. 1995), found throughout Canada and north-eastern US (USDA NRCS n.d.).

Alaska, Yukon to central British Columbia east to Labrador, Newfoundland south to Great Lakes, New Jersey (Moss 1983).



Developing *Larix* cones

Phenology

Blooms in mid spring (April to May), produces seed in the summer and it ripens and is dispersed in the fall (USDA NRCS n.d.).

Trees are approximately 5 to 20 years old before seed is produced (Tosh and Powell 1991). Female plants mature at 10 years and peak at 75 years (Government of the Northwest Territories n.d.).

Good cone crops are produced every 3 to 6 years (Government of the Northwest Territories n.d., Young and Young 1992).

Pollination

Wind pollinated.

Seed Dispersal

Wind (Royal Botanic Gardens Kew 2008).

Genetics

2n=24 (Moss 1983).

Symbiosis

Associated with ectomycorrhizal fungi particularly from genus *Fuscobolentinus* and genus *Suilus* (Samson and Fortin 1988).

Seed Processing

Collection: Cones can be picked from trees or from felled slash into sacks.

Fruit Weight: 55 kg of cones (35 L) produces approximately 1.7 kg of seed.

Seed Weight: 1.43 g/1,000 seeds (Young and Young 1992).

2 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Harvest Dates: Collect August 15 to September 15 (Formaniuk 2013).

Although seed dispersal can be delayed and occur throughout the winter it is recommended that cones should be harvested from trees as soon as they are ripe as early dispersal is common.

Cleaning: Air dry cones or kiln at 40°C until cones open; for recalcitrant cones soak in 40°C water, kiln dry for up to 8 hours (or until they open), tumble or shake to release seeds and then dewing by rubbing or using a dewinger (Wood pers. comm.).

Storage Behavior: Orthodox (Royal Botanic Gardens Kew 2008).

Storage: Store dry at 1 to 3°C for short periods, longer storage should be at -18 to 20°C in airtight containers. Moisture content should be below 8% for storage (Palamarek pers. comm.).

Hermetic storage at 2 to 4°C with seed moisture content at 2% to 5% (Royal Botanic Gardens Kew 2008).

Longevity: Up to 10+ years at -18 to 20°C in airtight containers (Palamarek pers. comm.).

Still has 50% germination after 15 years of hermetic storage (Royal Botanic Gardens Kew 2008).

***Larix laricina* forest.**

Propagation

Natural Regeneration: From seed and predominately layering in northern climates (Rook 2002).

Germination in nature is often very low due high seed predation by small mammals (USDA NRCS n.d.).
Germination: Seeds exhibit physiological dormancy. Germination is greater in light than dark (Baskin and Baskin 2002).
Pre-treatment: 21 days stratification (Formaniuk 2013).
Generally seedlings emerge in approximately two weeks after seeds have been cold stratified for three weeks (Wood pers. comm.). 30 to 60 days cold stratification (Baskin and Baskin 2002). Germination increased when seed was cold stratified and left to germinate at low temperatures (Baskin and Baskin 2002).
Direct Seeding: No literature found.
Planting Density: 1,000 to 3,000 plants /ha (USDA NRCS n.d.).
Vegetative Propagation: From cuttings (USDA NRCS n.d.).
Micro-propagation: Micro-propagation of 30 year old specimens of *L. laricina* by Bonga and Pond (1991) was unsuccessful as no adventitious buds grew.
Greenhouse Timeline: Grow for 170 days before harvest (Formaniuk 2013).

***Larix laricina* seed (black line is 5 mm)**

Aboriginal/Food Uses

Food: Young buds are sweet, raw or cooked (Gray 2011) although not commonly used for food (Johnson et al. 1995) except in times of emergency (Wilkinson 1990). Sap has been used as a natural sweetener and the inner bark can be ground into a powder and used as flour (Gray 2011).
Medicinal: A poultice made from boiled inner bark and wood can be used to relieve frostbite, deep cuts and burns, and the sap can be chewed to treat indigestion (CYSIP: Botany n.d., Johnson et al. 1995, Royer and Dickinson 1996, 2007).
The needles are high in vitamin C, and tea made from the needles can prevent scurvy and treat sore muscles, arthritis and diabetes (CYSIP: Botany n.d., Johnson et al. 1995).
The gum (resin) of larch species can be chewed to relieve indigestion (Wilkinson 1990) or treat infected gums (Gray 2011) or applied as a wash or poultice on wounds (Gray 2011).
Other: Wood used to make snowshoes, toboggans and canoes and roots split to make rope and nets for fishing (CYSIP: Botany n.d., Gray 2011). Rotten wood used for tanning to give hides a yellow colour (Royer and Dickinson 1996).

Wildlife/Forage Uses

Moose and white-tailed deer generally avoid eating tamarack; however it provides valuable cover (Uchytil 1991).
Red squirrels, pine siskin, crossbills, mice, voles, and shrews eat tamarack seeds (Uchytil 1991).
Sharptail grouse eat the buds (Hardy BBT 1989).
Snowshoe hares feed on twigs and bark, and porcupines feed on the inner bark (Government of the Northwest Territories n.d., Uchytil 1991).

Reclamation Potential

In field trials at Syncrude *Larix* seedlings planted into 100 cm of stockpiled peat over CT had significantly greater survival than seedlings in 15 cm cover (50 cm cover produced intermediate results); watering plots with oil sands process-affected water resulted in no survival (Wytrykush et al. 2012).
A pioneer species in moist habitat and can tolerate acidic and low nutrient soils, therefore potentially useful for reclamation in specific areas.

Is shade intolerant and not highly competitive (USDA NRCS n.d.).

Commercial Resources

Harvest Methods: Generally cones are gathered from felled slash, but can be picked from trees or obtained from squirrel cashes (Wood pers. comm.).
Availability: Grown in Alberta nurseries.
Uses: This strong wood can be used for fence posts, railway ties and boat building (Hardy BBT Limited 1989) as well as for fuel and pulpwood products (USDA NRCS n.d.). Bark is a source of tannin for tanning leather (Wilkinson 1990).

Notes

Synonyms include *Larix alaskensis*, *Larix laricina* var. *alaskensis* and *Pinus laricina*, none of which are valid (ITIS n.d.).
Tamarack is listed as 95% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: USDA-NRCS PLANTS Database / USDA NRCS. Wetland flora: Field office illustrated guide to plant species. USDA Natural Resources Conservation Service.
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Photo 4: Lindsay Robb @ Alberta Tree Improvement and Seed Centre 2013.

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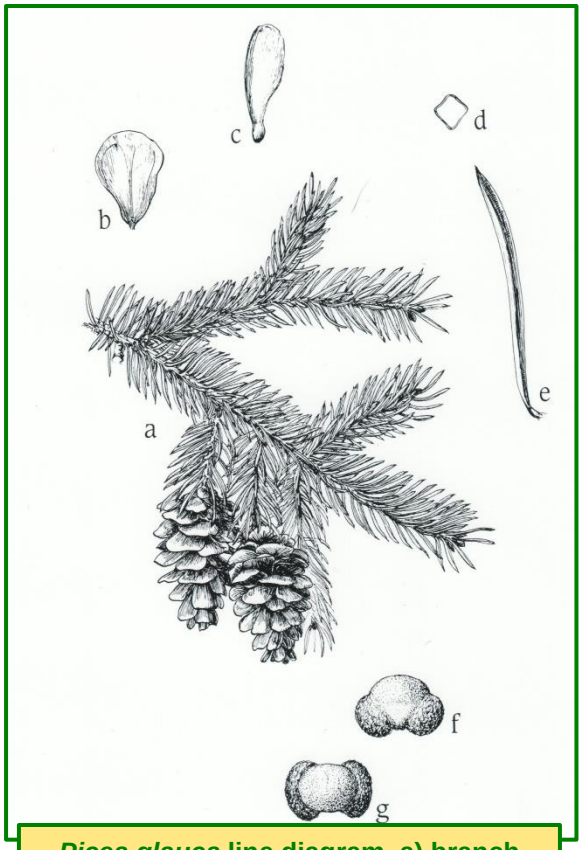
Scientific Name: *Picea glauca* (Moench)Voss **Family:** *Pinaceae*

Common Name: white spruce, Canadian spruce, cat spruce



***Picea glauca* line diagram a) branch with female cones b) ovuliferous scale c) seed d) leaf (x-section) e) leaf f-g) pollen**

Plant Description

Common tree in boreal forests, up to 40 m tall; bark ashy brown, sometimes reddish; narrow crown consisting of spirally arranged branches with twigs extending from all sides; leaves are 4-sided, pointed but not sharp, green to bluish-green, lines of white dots on all sides, borne singly; slender, cylindrical seed cone, 3 to 6 cm long, blunt-tipped, stalkless; scales light brown, outer margins of the scales are smooth (Farrar 1995, Moss 1983). Plants live for 200 years (Government of the Northwest Territories n.d.).

Seed: 2 to 4 mm wide and 4 to 8 mm long (Farrar 1995).

Habitat and Distribution

Common tree in northern forests and widespread throughout Alberta.

Seral Stage: Climax (Rook, 2002, Uchytil 1991). High shade tolerance (Hardy BBT Limited 1989).

Soil: Fine to coarse textured soil, high drought tolerance, pH 4.0 to 8.2 (USDA NRCS n.d.).

Best growth on well drained silty soils with adequate moisture (Hardy BBT Limited 1989). Can withstand flooding during growing season (Hardy BBT Limited 1989).

High acid tolerance; intolerant of salinity (Hardy BBT Limited 1989).

Distribution: Alaska to northern Montana east to Labrador, Newfoundland south to Great Lakes (Moss 1983).

***Picea glauca* enlarged seed with cross-section**

Phenology

Cones open in late summer (Government of the Northwest Territories n.d.); seeds are released from late summer to spring (Farrar 1995). Trees begin

producing seed at the age of four but they produce their best quality seed around 30 years of age (Rook 2002, Uchytil 1991). Trees can live up to 1,000 years old in some areas (Uchytil 1991).

Pollination
Wind.

Seed Dispersal
Wind with some caching by squirrels (Rook 2002, Uchytil 1991).

Genetics
2n=24 (Moss 1983).

Symbiosis
Forms mycorrhizal associations with ectomycorrhizal basidiomycetes *Thelephora americana* and *Amphinema byssoides* in container seedlings. Seedlings also associate with VAM and *Helotiales*, close to ericoid mycorrhizae (Kernahgan et al. 2003). Hydraulic conductance is improved by association with ectomycorrhizae (Landhausser et al. 2002).

***Picea glauca* new growth**

Seed Processing
Collection: Collect August 15 to September 15 (Formaniuk 2013).
Collected by climbing ladders or cutting down the tree as the cones develop at the top (crown) of the tree. Harvesters pick cones with lard or vegetable oil on their hands to prevent them from sticking.
Seed Weight: 0.16 g/1,000 seeds (Gerling et al. 1996).
0.12 g/1,000 seeds (Burton and Burton 2003).
Harvest Dates: August.
Cleaning: Cones open when they are dried, often using heat; seeds can be separated from the cone by winnowing.
Storage Behaviour: Orthodox, dry seeds to low relative humidity prior to cold storage (Royal Botanic Gardens Kew 2008).
Storage: 40% germination following 15 years hermetic storage at -4°C; viability maintained for 5 to 17 years in hermetic storage at 2 to 4°C with 4% to 8% moisture content; 0% to 14% viability lost after 17 to 20 years hermetic storage at 2 to 4°C with 3.6% to 5.5% moisture content; 47% to 81% viability lost after 21 to 34 years with 8.5% to 9% moisture content (Royal Botanic Gardens Kew 2008). Remains viable for up to 10 years (Uchytil 1991).
Longevity: 34 years (Royal Botanic Gardens Kew 2008).

Propagation
Natural Regeneration: Naturally regenerates from seeds, however it is possible for *Picea glauca* to reproduce vegetatively by layering (Uchytil 1991) though not as well as *P. mariana* (CYSIP: Botany n.d.).
Germination: 8 to 10 days germination (Wood pers. comm.).
Pre-treatment: 21 day cold stratification (Formaniuk 2013, Wood pers. comm.).
Direct Seeding: Field germination of seed rarely exceeds 30% of laboratory germination. Canadian average 123,552 seeds/ha. Manitoba 98,842 to 395,368 seeds/ha and Alberta uses 49,421 to 74,132 seeds/ha (Barth 1986).

Planting Density: Recommended planting densities for a variety of oil sands ecosites is provided in Alberta Environment (2010).
740 to 1,729 plants/ha (USDA NRCS n.d.).
Vegetative Propagation: Can be propagated by layering (Uchytil 1991) and cuttings though not done regularly (USDA NRCS n.d.).
Greenhouse Timeline: 24 to 28 weeks in the greenhouse until out-planting. Can be over wintered for a spring or fall planting the following season (Wood pers. comm.). Grow for 170 days before harvest (Formaniuk 2013).

***Picea glauca* understory in a *Populus tremuloides* stand**

Aboriginal/Food Uses

Food: Inner bark can be dried and ground to be added to flour in times of shortage; young shoots can be stripped of their needles and boiled as an emergency food high in vitamin C (CYSIP: Botany n.d., Gray 2011), branches can be made into tea (Mackinnon et al. 2009). Spruce tip jelly is used as a topping for toast and goes well with meats and poultry (Gray 2011).
Medicinal: The sticky sap or inner bark was used as poultices on slivers, sores and inflammations, was also mixed with fat to make salves for treating skin infections, insect bites, chapped hands, cuts, scrapes, eczema, burns, rashes, blood poisoning, heart trouble, syphilis and arthritic joints, was also placed on the eye for snow blindness. Spruce gum was chewed to treat sore throats and coughs, melted sap was used as a plaster when setting broken bones, it was also taken to help with digestion and gonorrhea. Medicinal tea was made from the bark to treat rheumatism, kidney stones and stomach problems and needle teas where to stimulate sweating and treat scurvy. The cone was used for toothaches, venereal disease, pain, urinary troubles and to assist women after childbirth. The roots are used to treat trembling and fits, stomach pain and diarrhea (Gray 2011, Mackinnon et al. 2009).
Other: Was used to make canoes, baskets, baby carriers, utensils and to thatch the roof of lodges; trunks sometimes used as teepee poles, to waterproof hide, make headgear and masks for ceremonies; roots used as lacing (Gray 2011, Mackinnon et al. 2009, Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Poor forage for deer, moose and elk. Seed is readily eaten by mice, voles, shrews, and red squirrels (Rook 2002, Uchytil 1991). Snowshoe hares sometimes feed heavily on saplings and seedlings (Hardy BBT Limited 1989, Rook 2002). Spruce grouse feed entirely on spruce needles during winter (Rook 2002).
Trees provide valuable nesting sites for birds (Lady Bird Johnson Wildflower Center 2013).
Livestock: Poor forage (Uchytil 1991).
Grazing Response: Seedlings are intolerant of grazing although older trees can tolerate small amounts of browsing.

Reclamation Potential

Are used for coal mine overburden revegetation (Uchytil 1991), oil and gas, and other reclamation projects. As a climax species in desired communities, *Picea* is often included in reclamation plans, however, ideal conditions are rarely present and growth is stunted.

Performance in several tests after 4 to 7 years on amended oil sands tailings and overburden indicated moderately good to excellent survival, good growth, no dieback and a positive response to heavy ground cover (Hardy BBT Limited 1989).

Commercial Resources

Availability: Trees are commercially available across Alberta (ANPC 2010).

Uses: Used for lumber (Borealforest.org n.d.) as well as landscaping purposes. This is the foremost pulpwood, and is valued for piano sounding boards, violins, and other musical instruments; it is generally the most important commercial tree species of Canada (Lady Bird Johnson Wildflower Center 2013, Wilkinson 1990).

Spruce beer is made from the young growing tips in the spring (CYSIP: Botany n.d., Gray 2011).

Spruce tips can be used in the bath and as a facial steam for oily skin (Gray 2011).

Notes

Synonym *Picea canadensis* ((USDA NRCS n.d.).

P. glauca is listed as 92% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Trees are easily killed by fire due to thin bark (Rook 2002).

Trees are shallow-rooted and therefore not wind firm (Wilkinson 1990).

Trees are subject to attack by the spruce budworm (*Choristoneura fumiferana* Clemens)(Cerezke 1991).

Photo Credits

Photo 1 & 3: Wild Rose Consulting, Inc. 2013.

Photo 2: L. Robb. Alberta Provincial Seed Specialist. 2013.

Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Wood, B., 2011. Head Grower. Smoky Lake Tree Nursery. Personal communication.

Scientific Name: *Pinus banksiana Lamb* **Family:** *Pinaceae*

Common Name: jack pine

Plant Description

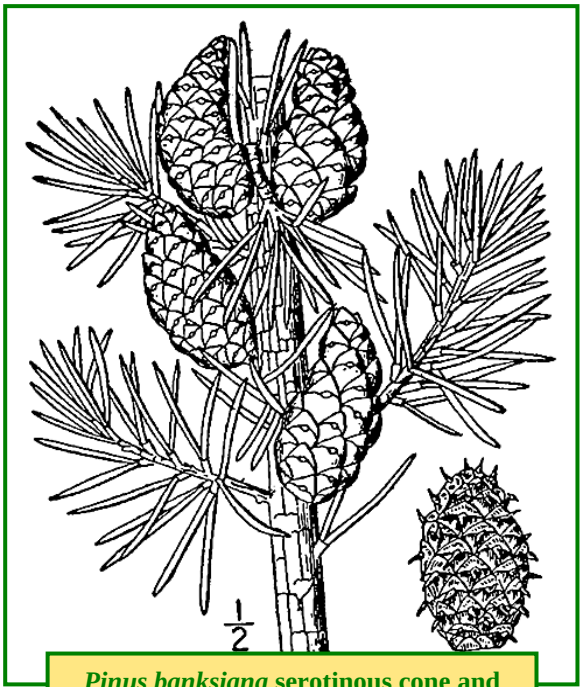
Common tree of south boreal region, up to 20 m tall or shrubby between 5 to 10 m; flaky red brown old bark becoming deeply grooved with aging; crown narrow with drooping lower branches when wide; leaves are paired needles with a papery basal sheath, yellow green; can be twisted and spreading; pollen cones clustered at branch ends, 1 cm in length; seed cone tan, curved towards branch tips, thickened smooth scales 3 to 7 cm long; cones serotinous without scale prickles at maturity (Farrar 1995). Plants live for 150 years (Government of the Northwest Territories n.d.).

Seed: Winged, small, black and ribbed (Farrar 1995).

Enlarged *Pinus banksiana* seeds showing cross-section.

Habitat and Distribution

Occurs on poor quality sites such as coarse sands, shallow soils and rock out crops, even on permafrost.



***Pinus banksiana* serotinous cone and paired needles**

Best growth occurs on moist upland, well-drained sandy soils (Hardy BBT Limited 1989).

Grows in pure or mixed stands and is shade intolerant (Farrar 1995, Rook 2002).

Seral Stage: *P. banksiana* is an early colonizer; thrives after fires (Government of the Northwest Territories n.d.). Intolerant of shade (Hardy BBT Limited 1989).

Soils: Can grow on fine to coarse textured soils with optimal soil pH 6.0 to 8.2 (USDA NRCS n.d.). Survives on nutrient-poor sites and has low nutrient requirements (Hardy BBT Limited 1989).

In a greenhouse study, Franklin et al. (2002) found jack pine seedlings were more sensitive to NaCl than Na_2SO_4 salts.

Distribution: Western District of Mackenzie to Newfoundland south to Great Lakes (Moss 1983).

Phenology

Flowering initiates in May to June of the first year with seeds maturing and dispersing in September the following season (Young and Young 1992).

Trees begin to produce viable seed between 3 and 15 years of age (females mature at 5 to 10 years –

Government of the Northwest Territories n.d.). The cones turn from green to shiny yellow or brown when they are ripe (Bonner and Karrfalt 2008).

Pollination

Pinus spp. are monoecious and female cones are generally found in the upper crown of the tree whereas the males are found in the lower crown (Young and Young 1992).

Pinus banksiana

Seed Dispersal

Dispersal occurs 13 months after pollination. Serotinous cones require heat to open. Wind dispersed following fire as well as some caching by seed predators. Wind dispersed to a maximum of 33 to 39 m (Rook 2002).

Genetics

2n=24 (Moss 1983).

Symbiosis

Are usually colonized by ectomycorrhizal fungi (Hardy BBT Limited 1989) as well as arbuscular mycorrhizae and dark septate endophytic fungi (Wagg et al. 2008). Danielson (1994) listed 56 fungi species found at the Richardson Fire Tower near Fort McMurray that were considered to be potential symbionts of jack pine.

Seed Processing

Collection: Ripe cones are tawny yellow and larger cones generally contain more seeds. Ripe cones can be collected from standing trees, freshly fallen trees and animal caches (Young and Young 1992).
Seed Weight: 3.47 g/1,000 seeds (Young and Young 1992).
Seed per Fruit: 10 g seed/kg of cones (Bonner and Karrfalt 2008).
Harvest Dates: August to October. Collect anytime (Formaniuk 2013).
Cleaning: Dry in kiln for 2 to 4 hrs at a temperature of 72°C (Young and Young 1992). Seed shed from cones can be screened to remove chaff.
Storage Behaviour: Orthodox; dry seed to low relative humidity prior to cold storage (Royal Botanic Gardens Kew 2008).
Storage: As a general rule *Pinus* spp. should be dried to a moisture content between 5% and 10% before storing at cold temperatures ranging from 2 to 5°C (Young and Young 1992). In Alberta, seeds are dried to 5% to 8% moisture and stored at -18°C (Palamarek pers. comm.).

Longevity: 10 years or longer (Government of the Northwest Territories n.d., Palamarek pers. comm., Young and Young 1992). Up to 50% of 20-year-old seed may be viable (Rook 2002).

Propagation

Natural Regeneration: By seed and by layering (Farrar 1995). Layering is often the primary method of reproduction on organic soils where conditions for seed germination are poor (Farrar 1995). Seed regeneration is common after fire.
Germination: Epigeal germination takes 14 days at 20/30°C (Young and Young 1992).
72 to 86 % germination after 9 to 10 days, 8 hours of light at a temperature of 30°C and 16 hours dark at 20°C (Bonner and Karrfalt 2008).
Pre-treatment: Overnight soak in water (Wood pers. comm.). 14 days stratification (Formaniuk 2013).
Direct Seeding: Can be sown in either the spring or winter at a depth of 0.6 cm (Young and Young 1992).
Seed Rate: 320 seeds per m^2 (Young and Young 1992).
Planting Density: Recommended planting densities for a variety of oil sands ecosites is provided in Alberta Environment (2010).
Greenhouse Timeline: 20 to 22 weeks in the greenhouse prior to out-planting. Dormant plants can be overwintered frozen for planting in spring (Wood pers. comm.). Grow for 150 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Other: Trunks were used as canoe timbers (USDA NRCS n.d., Wilkinson 1990).

Wildlife/Forage Usage

White-tailed deer browse saplings and young trees; intermediate forage for white tail deer (USDA NRCS n.d.).
Snowshoe hares feed on seedlings; porcupines feed on bark; red squirrels, chipmunks, mice, goldfinches, and robins consume seeds (Rook 2002, USDA NRCS n.d.).
Will sustain light to moderate browsing (Hardy BBT Limited 1989).
Provides shelter for white-tailed deer and snowshoe hare (Borealforest.org n.d.).

Reclamation Potential

After seven years testing on amended tailings sands near Fort McMurray, jack pine had the highest survival, vigour and growth. At another site jack pine survival levelled off at 70% at four years. Competition from ground cover appeared to reduce survival (Hardy BBT Limited 1989).
Farnden et al. (2013) showed that jack pine heights on a reclaimed oil sands tailings dyke at Syncrude were affected more by soil organic matter content than soil depth. The effects were more pronounced for organic matter content increases up to 8% and less pronounced thereafter.
In a greenhouse trial, Danielson and Visser (1988, 1989) found container-grown jack pine inoculated with 12 fungi resulted in 9 of the species forming mycorrhizae. The seedlings were planted on a tailings dyke at Syncrude and after one season four of the species had infected new roots extending into the surrounding reconstructed soil. By the end of the 3rd season only one species (E-strain) remained. Resident fungi had taken over the seedlings by end of the 3rd season. Seedling shoot weight was higher with inoculation but the advantage over the controls decreased by the 3rd season.
Jack pine has shown growth on anthracite (coal) spoils and is recommended for oil sands planting in Northeastern Alberta, at a density of 1,111 stems/ha or 687 stems/ha on overburden sites (Carey 1993).
Pinus banksiana colonizes areas where disturbance, such as fire, has exposed the mineral soil. It also grows on stabilized sand dunes (Carey 1993).

Commercial Resources

Availability: Plants are available in Alberta (ANPC 2010).
Cultivars: Horticultural cultivars are not suitable for reclamation.

Uses: Important source of commercial timber – lumber, railway ties, timbers, telephone poles, fence posts, pilings, silos – and pulpwood (Borealforest.org n.d., Rook 2002, USDA NRCS n.d., Wilkinson 1990).

Notes

Synonym *Pinus divaricata* (Bonner and Karrfalt 2008).
Hybrids occur with *Pinus contorta* (lodgepole pine) with fertile offspring (Farrar 1995, Inkpen and Van Eyk n.d.).
P. banksiana is listed as 95% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Planting, direct seeding, scattering of slash with cones, seed tree and burn silviculture are all used for stand regeneration (Carey 1993).
Roots may extend 2.74 m deep though most roots are within the upper 0.5 m of soil (Rook 2002).

Photo Credits:

Photo 1: Wikimedia Commons, Accessed at http://commons.wikimedia.org/wiki/File:Pinus_banksiana.jpg May 28, 2012.
Photo 2: K. Wood. Alberta Provincial Seed Technician 2013.
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Scientific Name: *Populus balsamifera* L **Family:** *Salicaceae*

Common Names: balsam poplar, black poplar

***Populus balsamifera* seeds**

Plant Description

Tree up to 25 m tall with broad crown and dark furrowed bark; twigs brown; buds coated with a viscid gum; leaf blades 6 to 12 cm long, ovate to ovate-lanceolate, rounded to cuneate or somewhat cordate at base, deep green above, silvery whitish or pale brownish beneath, margins crenate-serrate; petioles 2 to 5 cm long (Moss 1983). Plants live to 70 years (Government of the Northwest Territories n.d.).

Fruit: Mature catkins 10 to 13 cm; capsules ovoid, larger hairless, 6 to 7 mm long, splitting into 2 parts when mature (Farrar 1995).

Seed: Approximately 2.5 mm long, light golden brown, lance shaped, covered in white fluff (Farrar 1995).

Habitat and Distribution

Found in river valleys, moist rich low lying ground (Farrar 1995).

Seral Stage: Shade intolerant, early successional species (Tannas 1997, USDA NRCS n.d.).

Soil: Does well in a variety of soil types in a pH range 4.5 to 7 (USDA NRCS n.d.). It has no salinity tolerance (Hardy BBT Limited 1989, USDA NRCS n.d.).

Abundant soil moisture needed but stagnant brackish water intolerable (Rook 2002).

Distribution: Alaska, Yukon, southern District of Mackenzie to Hudson Bay, Newfoundland south to California, Utah, Wyoming, southern Saskatchewan, southern Manitoba, Great Lakes (Moss 1983).

Phenology

Plants flower in April; seeds ripen in May and June (Young and Young 1992).

Begins to flower at 8 years (Harris 1990); 8 to 10 years (Government of the Northwest Territories n.d.).

Pollination

Wind pollinated (Plants for a Future n.d.).

Seed Dispersal

Wind dispersed.

Genetics

2n=38 (Moss 1983).

Symbiosis

Forms mycorrhizal associations. In particular, ectendomycorrhizal association is made with E-strain

fungi including an extensive Harig net between cortical cells and vascular cylinder (Siemens and Zwiazek 2008).

Seed Processing

Collection: Collect when green and allow capsules to open by drying (Young and Young 1992).
Seed Weight: 0.24 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: End of May to early June, as soon as first fluff is in the air. Collect May 15 to May 31 (Formaniuk 2013).
Cleaning: Vacuum screening has been used to pull fluff from seeds.
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents; their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Stored at -10°C in sealed containers (Zasada and Densmore 1980).
Optimum relative humidity appears to be 10% (Royal Botanic Gardens Kew 2008).
Longevity: Seeds lose viability quickly (Young and Young 1992). Was found to retain viability for up to 3 years (Zasada and Densmore 1980). Palamarek (pers. comm.) found balsam poplar seed retained viability for 4 to 6 years.

Propagation

Natural Regeneration: Spreads by seed and vegetative means (Burns and Honkala 1990).
Germination: Fresh seed got 98% to 100% germination within 3 days at temperatures between 5 and 25°C. They do not show any kind of dormancy and will germinate in temperatures from 2 to 40°C (Burns and Honkala 1990).
Pre-treatment: No pre-treatment required (Burns and Honkala 1990, Formaniuk 2013, Young and Young 1992).
Direct Seeding: *Populus balsamifera* seeded on the Clover Bar Landfill in Edmonton had 11% survival after the first year (Smreciu 1997).
Vegetative Propagation: Can be propagated by either softwood or hardwood cuttings (Plants for a Future n.d., Wick et al. 2008).
Greenhouse Timeline: Grow for 120 days before harvest (Formaniuk (2013).

***Populus balsamifera* has resinous, aromatic buds**

Aboriginal/Food Uses

Food: Cambium can be scraped off and eaten; also used as a starvation food (Marles et al. 2000, Turner 1997, Wilkinson 1990). Catkins are high in Vitamin C and can be eaten raw or added to soup or stew (Gray 2011).
Medicinal: Sap can be drunk to treat diabetes and high blood pressure. Sap and bark boiled together were used to treat asthma. Extract can be rubbed on to treat skin diseases as well as to relive teething pain in babies. Also to treat heart problems, stomach aches and to draw out infections from sores (Marles et al. 2000).
Inner bark tincture is a natural remedy for fevers, rheumatism, arthritis and diarrhoea (Gray 2011).

Resin from buds used to treat sore throats, coughs, lung pain, and rheumatism (Rook 2002) and to treat snow blindness (Wilkinson 1990).
Other: Wood is not very strong but was carved into toy boats, paddles, pack-saddles, and cradleboards (Marles et al. 2000, Wilkinson 1990).
Ash used to make a soap substitute (Wilkinson 1990).
Roots split to make rope (Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Moose, deer and snowshoe hare browse this species (Harris 1990).
Provides shelter for wildlife as well as an important food source for beavers (Eaton et al. 2013, Tannas 1997).
Livestock: Poor forage; not utilized if better food sources are available (Tannas 1997).
Grazing Response: Increaser, a very aggressive competitor in their adapted ranges (Tannas 1997).

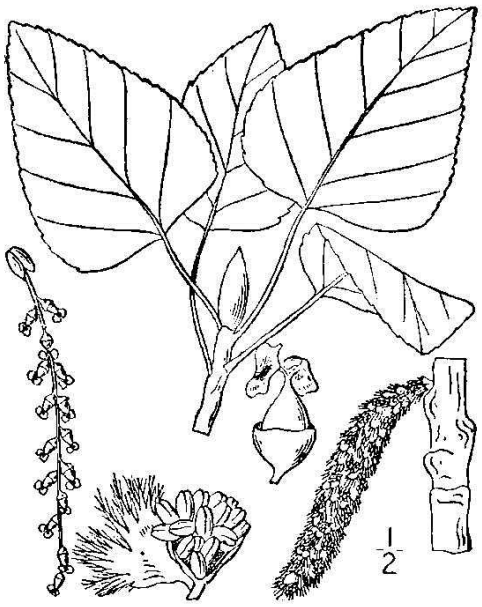
Reclamation Potential

Populus balsamifera can quickly colonize after natural or human disturbances and grow rapidly where light, exposed mineral soil, and moisture are readily available as well as provide cover for other slower growing plant species (Burns and Honkala 1990).
P. balsamifera can be used to stabilize river banks and maintain river islands, recolonize sites disturbed by fire or logging, and has been successful at naturally colonizing borrow pits and abandoned coal mine sites (Harris 1990).
"Northwest" hybrid was the best poplar after six years (tallest, largest stem, highest vigour and lowest dieback) on amended tailings sand near Fort McMurray. Survival after four years on amended tailings sand was 60 to 70% under moderate to heavy ground cover. Growth of the container stock averaged 14 cm/year during this period (Hardy BBT Limited 1989).

Commercial Resources

Availability: Plants are commercially available in Alberta (ANPC 2010).

Cultivars: There are horticultural cultivars; none are suitable for reclamation in Alberta.
Uses: Used for firewood, windbreaks, boxes, plywood, lumber, particle board and pulpwood (Borealforest.org n.d., Harris 1990, Tannas 1997).



Populus balsamifera: **Leaves, male and female catkin.**

Notes

Northern-most occurring of all North American hardwoods (Rook 2002).
P. balsamifera is listed as 91% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Plants are subject to attack by the large aspen tortrix (*Choristoneura conflictana* (Walker) when they are epidemic (Cerezke 1992).

Photo Credits

Photo 1: Matt Lavin Wikimedia Commons
http://commons.wikimedia.org/wiki/File:Populus_balsamifera_%285002985204%29.jpg
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Scientific Name: *Populus tremuloides* Michx **Family:** *Salicaceae*

Common Names: trembling aspen, quaking aspen, aspen poplar, white poplar

Plant Description

Small to mid-height deciduous tree in stands and clumps due to proliferous spread of suckers from roots; bark greenish to white darker near base; buds non resinous or fragrant; leaf obovate and sharp tipped, 3 to 7.5 cm long finely round toothed flattened stalks; flowers form drooping catkins (Moss 1983). Plants live to 80 years (Government of the Northwest Territories n.d.).

Fruit: 3 to 5 mm long capsules.

Seed: Light brown to cream coloured, small somewhat obovate seed (~1 mm long) with tuft of hair.

Habitat and Distribution

Forests and parklands (Moss 1983). Grows along forest edges and waterways – shade intolerant (Rose et al. 1998). Occurs in pure stands, especially as a young tree (Wilkinson 1990).

Seral Stage: Early.

Soil: Adapted to a wide range of soil textures and can tolerate soil pH range 4.3 to 9 (USDA NRCS n.d.). Optimal moisture regime is submesic to subhydric (Beckingham and Archibald 1996).

Distribution: Forest and parkland; Alaska, Yukon, southern District of Mackenzie, to James Bay, Newfoundland south to California, New Mexico, Missouri, Tennessee, New Jersey (Moss 1983).

Phenology

Female plants mature at 8 to 10 years (Government of the Northwest Territories n.d.). Aspen flowers in mid-April to early May, with seeds ripening within 4 to 6 weeks of flowering. Good seed crops occur every 4 to 5 years (Farrar 1995, Government of the Northwest Territories n.d.), though, this may be cyclical for a clone rather than a population. Blooming date has advanced by two weeks since 1936 due to climate change, increasing the species' susceptibility to frost damage (Beaubien and Hamann 2011).

***Populus tremuloides* cloned stand**

Pollination

Wind pollinated (Cox 1988).

Seed Dispersal

Dispersed soon after ripening up to several kilometres in high winds (Rook 2002).

Genetics

n=38 (Moss 1983).

Symbiosis

Ectomycorrhizal associations can increase hydraulic conductance of aspen, especially in colder climates

(Landhausser et al. 2002). Dual associations with arbuscular mycorrhizae and ectomycorrhizae where arbuscular mycorrhizae are more beneficial and likely to colonize in areas with low organic matter and ectomycorrhizae are more likely to colonize in areas with high organic matter and low pH, or nearer the surface where decomposition is taking place (Neville et al. 2002).

Seed Processing

Collection: Pole-pruners may be used to harvest individual branches from shorter trees, or entire trees can be felled. Branches may stored in tubs of water for after-ripening (3 days to 1 week) which can extend the harvest period tremendously (Moench 1999). As soon as the first capsules crack, begin harvesting to prevent loss when felling branches or whole trees. Also, because different clones will ripen at different times, it is possible to stagger collection somewhat.

Catkins may be stripped into buckets or bags as long as they are stored in small containers and quickly moved to refrigerated conditions to prevent further ripening. To ensure complete cooling, capsules should be packed lightly, spread out in a single layer if possible (Smreciu et al. 2013). If immediately drying seed, cover with screening material, such as burlap, to prevent seed loss by air movement. Kept cool (4ºC), capsules may be stored up to two weeks before cleaning (Smreciu et al. 2013).

Seed Weight: 0.1 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Harvest Dates: Varies, usually in late April or early May. Collect May 15 to May 31 (Formaniuk 2013).

Cleaning: Seeds with pappus attached can be placed in a sieve with openings large enough for seed to fall through (between 10 and 20-mesh) (Smreciu et al. 2013).

Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).

Storage: Cleaned seeds must be planted as soon as possible or stored frozen (Smreciu et al. 2013). Optimum air humidity for storage appears to be 15% to 25% relative humidity; 70% germination after 2 years storage at -5°C with 10% relative humidity; 97% germination following 1 year air-dry hermetic storage at 5°C; no loss in viability after 16 months hermetic storage at -10°C with 6% to 10% moisture content (Royal Botanic Gardens Kew 2008).

Longevity: Seeds can remain viable for one year of storage at 5°C with 5% to 8% moisture (Rose et al. 1998).

Seeds retain viability for up to six years at -18ºC (Palamarek pers. comm.).

Green catkins

Propagation

Natural Regeneration: Regenerates from seed and by sprouting from the roots to form clones (Howard 1996, Wilkinson 1990).

Germination: Viability of fresh seed is good; germination of 80% to 95% is reported under laboratory conditions (Howard 1996).

Viability lasts 2 to 4 weeks under favorable conditions of low temperature and humidity, but seed loses viability rapidly under less than optimum conditions (Howard 1996).

Pre-treatment: No pre-treatments required (Formaniuk 2013, Wood pers. comm.).

Direct Seeding: No literature found.
Planting Density: 741 to 2,965 trees per hectare (USDA NRCS n.d.).
Seed Rate: No literature found.
Vegetative Propagation: Propagated by root cuttings and stem cuttings (Wood 2011).
Micro-propagation: No literature found.
Greenhouse Timeline: 16 weeks in the greenhouse prior to out-plant. Seedlings can be stored frozen over winter for out-planting in the following spring (Wood pers. comm.). Grow for 100 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Strips of raw pulp material under bark consumed as a sweet treat and are a very nourishing survival food (Gray 2011, Marles et al. 2000). Regarded as *famine food* (Wilkinson 1990). Catkins are high in Vitamin C and can be eaten raw or added to soup or stew (Gray 2011).
Medicinal: Bark contains salicin which is believed to decompose to a salicylic acid-like compound (the main ingredient in aspirin) in humans (Gray 2011, Wilkinson 1990). Buds, inner bark, and leaves used as medicine, tea from inner bark made for treatment of rheumatism, diarrhoea, liver and kidney problems. White powder on bark used to clot blood and as a sunscreen (Gray 2011, Tannas 2003). Seeds chewed to increase chances of abortion.
Other: Wood used to make dugout canoes, canoe paddles and tent poles (Marles et al. 2000, Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Older trees provide shelter and protection for many types of animals including deer, moose, beaver and birds. Younger trees provide browse for porcupine, rodents and rabbits (Howard 1996). The preferred food of beaver (Eaton et al. 2013).
Livestock: Palatable for livestock (Hardy BBT Limited 1989).
Grazing Response: Increaser. High intensity grazing can be used to control spread (Tannas 2003).

Reclamation Potential

Survival of trembling aspen on amended tailings sand in northern Alberta was variable. Greatest survival was recorded on plots where grass and legume cover was least. This suggests that during early establishment, trembling aspen cannot compete with grasses for moisture, particularly during dry years. Plantings on amended tailing sand had low survival after 7 years, however this may be attributable to poor planting stock. In operational plantings trembling aspen third year survival was 85% with a sparse ground cover but annual growth was relatively poor (10 cm vs. 35 cm for "Northwest" balsam poplar)(Hardy BBT Limited 1989).
In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that aspen was the only tree species that invaded and persisted on reclaimed sites.
Research has been done into using *P. tremuloides* as a keystone species in reclamation due to its ability to grow quickly and its high genetic variability as well as its value as a commercial resource (Landhausser 2013).
Aspen has been used in the reclamation of riparian habitats for erosion reduction (USDA NRCS n.d.). Grows in areas where soils have been disturbed by logging and by fire (Rose et al. 1998).
Wide spreading roots and accompanying communities provide good soil stabilizing conditions and potential.
Leaves decay relatively rapidly, returning nutrients to the soil (Rook 2002).

Commercial Resources

Availability: Can buy seedlings from nurseries across Alberta.
Cultivars: No literature found.
Uses: High grades of aspen are used for lumber, veneer, furniture, lumber, boxes and wooden matches. Aspen makes particularly good sauna benches and playground structures because the wood surface does not splinter. Most aspen wood goes into pulp and particleboard, however (Borealforest.org n.d., Farrar 1995).

Notes

Trembling aspen is the most widely distributed tree in North America (Borealforest.org n.d.).
Populus tremuloides is listed as 92% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Subject to attack by the large aspen tortrix (*Choristoneura conflictana* (Walker)(Cerezke 1992).

Photo Credits

Photo 1: Wild Rose Consulting, Inc.
Photo 2: Wikimedia commons. Accessed http://commons.wikimedia.org/wiki/File:Quaking_aspen_Populus_tremuloides_trio.jpg.

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APPENDIX 2: Shrubs

The following shrub species are profiled in this Appendix.

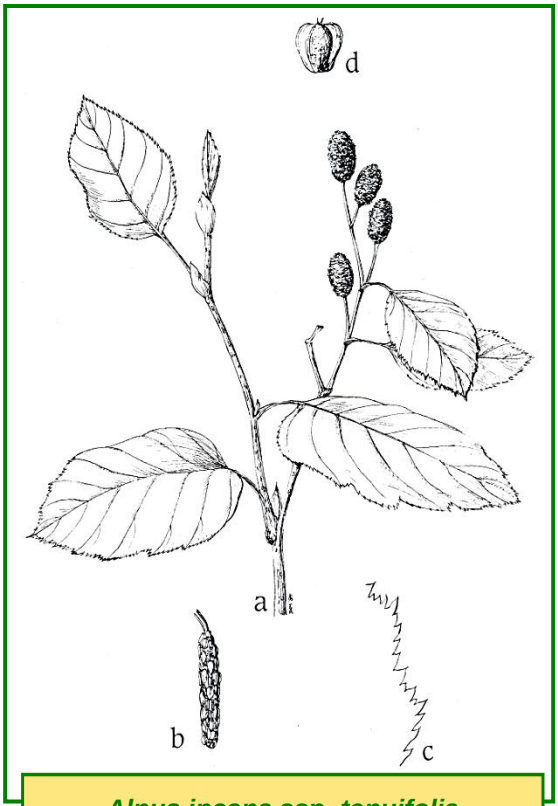
Scientific Name	Common Name	Family
Alnus incana ssp. tenuifolia	river alder, thin leaf alder, speckled alder, gray alder	Betulaceae
Alnus viridis ssp. crispa	green alder, sitka alder, mountain alder, wavy-leaf alder, slide alder	Betulaceae
Amelanchier alnifolia	saskatoon, service berry, June berry, shadbush, shadblow, indian pear, may cherry	Rosaceae
Arctostaphylos uva-ursi	bearberry, kinnikinnick, red bearberry, cowberry, manzanita, mealberry	Ericaceae
Betula nana	bog birch, arctic dwarf birch, swamp birch	Betulaceae
Cornus sericea ssp. sericea	red-osier dogwood, dogwood, red willow	Cornaceae
Corylus cornuta	beaked hazel, beaked hazelnut, western hazel, wild filbert, beaked filbert	Betulaceae
Dasiphora fruticosa	shrubby cinquefoil	Rosaceae
Hudsonia tomentosa	beach heather, woolly beach-heather, sand golden-heather	Cistaceae
Juniperus communis	common juniper, ground juniper, dwarf juniper, low juniper	Cupressaceae
Lonicera caerulea	blue fly honeysuckle, mountain fly honeysuckle, sweetberry honeysuckle, honeyberry	Caprifoliaceae
Lonicera dioica var. glaucescens	twining honeysuckle, limber honeysuckle	Caprifoliaceae
Lonicera involucrata	bracted honeysuckle, black twinberry, swamp honeysuckle	Caprfoliaceae
Prunus pensylvanica	pin cherry, fire cherry, wild red cherry, pigeon cherry, bird cherry	Rosaceae
Prunus virginiana	chokecherry, common chokecherry, Virginia chokecherry	Rosaceae
Rhododendron groenlandicum	Labrador tea, bog Labrador tea, rusty Labrador-tea, St. James' tea, marsh tea, swamp tea, Hudson's Bay tea	Ericaceae
Ribes glandulosum	skunk currant, skunk red currant, skunkberry, fetid currant	Grossulariaceae
Ribes hudsonianum	northern black currant, black currant, Hudson Bay currant	Grossulariaceae
Ribes lacustre	bristly black currant, prickly currant, swamp currant	Rosaceae
Ribes triste	swamp red currant, red currant	Grossulariaceae
Rosa acicularis	prickly rose, bristly rose	Rosaceae
Rubus arcticus ssp. acaulis	dwarf raspberry, arctic blackberry, arctic bramble	Rosaceae
Rubus idaeus	red raspberry	Rosaceae

Scientific Name	Common Name	Family
Rubus pubescens	dewberry, trailing raspberry, running raspberry	Rosaceae
Salix bebbiana	Bebb's willow, gray willow	Salicaceae
Salix exigua	sand bar willow, coyote willow, narrow leaf willow, desert willow	Salicaceae
Salix lucida	greenleaf willow, Pacific willow, shining willow	Salicaceae
Shepherdia canadensis	buffaloberry, Canadian buffaloberry, soapberry, russet buffaloberry, soopalalie	Elaeagnaceae
Sibbaldiopsis tridentata	three-toothed cinquefoil, shrubby five fingers	Rosaceae
Symphoricarpos albus	snowberry, common snowberry, white coralberry	Caprifoliaceae
Vaccinium myrtilloides	blueberry, velvet-leaf blueberry, Canada blueberry, velvet-leaf huckleberry	Ericaceae
Vaccinium oxycoccos	small bog cranberry	Ericaceae
Vaccinium vitis-idaea	bog cranberry, cowberry, lingonberry, mountain cranberry, partridgeberry, northern mountain cranberry, lowbush cranberry	Ericaceae
Viburnum edule	lowbush cranberry, mooseberry, squashberry, squawberry, crampbark, pembina	Caprifoliaceae

Scientific Name: *Alnus incana* ssp. *tenuifolia* Nutt. Breitung

Family: *Betulaceae*

Common Names: river alder, thin leaf alder, speckled alder, gray alder



Alnus incana* ssp. *tenuifolia
a. branchlet bearing seed cones.
b. pollen cone.c. leaf serations.
d. seed.

Plant Description

Large shrub or small tree 2 to 8 m tall; bark thin and smooth marked with orange lenticels; leaves oval to broadly ovate, doubly serrate 4 to 10 cm long and slightly pubescent beneath; flowers in catkins (Moss 1983).

Fruit: Short-stalked seed cones (catkins), 1 to 2 cm long.

Seed: Samaras, 2 to 3.5 mm, flat, ovoid, wingless, brown, rough.

Habitat and Distribution

Found in riparian, bog, and nutrient-rich swamp communities, on riverbanks and lakeshores. Low shade tolerance, tolerant of flooding (Hardy BBT 1989).

Soil: The pH range is 5.5 to 7. Adapted to a wide range of soil textures, however is most common in poorly drained soils (Healy and Gill 1974).

Distribution: Widespread across Alberta, frequent in all regions except the mixed grass prairie (Tannas 1997). Alaska, Yukon, western District of Mackenzie south to California, Colorado, western Saskatchewan (Moss 1983).

Phenology

Female plants mature in 5 to 10 years (Government of the Northwest Territories n.d.). Flowering from April to June. Fruits ripen late August through September. Seeds dispersed by wind during fall and winter (Healy and Gill 1974). Abundant seed crop every four years (Government of the Northwest Territories n.d.).

Pollination

Pollen (0.03 mm) spread by wind (CYSIP: Botany n.d., Healy and Gill 1974).

Genetics

2n=28 (Moss 1983).

Symbiosis

Arbuscular mycorrhizal symbiosis is critical for successful establishment of *A. incana* (Monzón and Azcón 2001). *Frankia* (nitrogen fixing soil bacteria) inoculation significantly increases biomass production (Hendrickson *et al.* 1993). Markham (2005) found inoculation with both *Frankia* and *Pacillus involutus* (a fungi forming ectomycorrhizal

systems) synergistically improved plant performance when grown on mine tailings.

***Alnus incana* developing male (bottom) and female catkins (top)**

Seed Processing

Collection: Catkins are easily stripped from branches, just prior to opening, and left to air dry.

Seed Weight: 0.382 to 0.627 g/1,000 seeds (0.490 average).

Harvest Dates: Harvest when the bracts start to separate on the earliest cones, generally in late August.

Cleaning: Air dry at ambient air temperature for several weeks. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens (1.20 or 1.40 mm). Small chaff and dust can be removed by winnowing.

Storage: Store hermetically in sealed containers at 2 to 5°C (Young and Young 1992). Orthodox (Hong et al. 2004), seed can be stored at freezing temperatures (-18ºC) provided seed is sufficiently dry (3% to 7% moisture content).

Longevity: When refrigerated in sealed containers (1 to 3°C), seeds can be stored and viable for up to 10 years (Healy and Gill 1974).

***Alnus incana* seed.**

Propagation

Natural Regeneration: Reproduction occurs mainly through sprouting from root crown but also through layers, suckers and underground stems (Fryer 2011) as well as from seed (Healy and Gill 1974).

Germination: 30% in 30 days from fresh or 1 year old seed from northeastern Alberta. *Alnus incana* seed development is variable with up to 95% of the seeds being empty (Fryer 2011).

100% germination was achieved by Kew on 1% agar media at temperatures of 25/15°C (8 hours day/16 hours night) (Royal Botanic Gardens Kew 2008).

Pre-treatment: Cold stratification of 30 to 90 days (Nichols 1934). King (1980) reported that fresh seeds may not need stratification, however, stored seeds with less than 10% moisture content may need cold stratification.

A. incana exhibits increased growth and vigour in full sunlight and better seed germination in saturated soil (Healy and Gill 1974).
Direct Seeding: No emergence within 5 years when seeded in reclaimed sites in northeastern Alberta. Successful in Pennsylvania: fall-collected seed was sown the following February and March in cool, moist sites close to a stream (Healy and Gill 1974).
Seeding Rate: 60 kg of seed/ha (Healy and Gill 1974).
Vegetative Propagation: By 30 cm hardwood cuttings (Babb 1959).
Micro-propagation: Can be micro-propagated (Perinet and Tremblay 1987).

Aboriginal/Food Uses

Food: Buds can be eaten. Inner-bark can be dried and ground into flour, or chewed as a survival food (CYSIP: Botany n.d.).
Medicinal: Inner bark used to wash sore eyes, bark used as laxative (Marles et al. 2000). Leaves used to treat blisters, inflammation and other foot ailments (CYSIP: Botany n.d.).
Other: Boiled bark and stem pieces are used to make red-brown dye for hides (CYSIP: Botany n.d.), and alder wood is used to make carved tools and implements (Marles et al. 2000).

Wildlife/Forage Uses

Wildlife: Moose, muskrats, beavers, cottontail rabbits and snowshoe hares feed on branches and foliage. Songbirds feed on seeds; grouse eat buds and catkins and use alder for cover. Commonly used by beavers for dam construction (Healy and Gill 1974).
The pollen is used by bees in spring for brood rearing (CYSIP: Botany n.d.).

Commercial Resources

Availability: Available as seed and/or plants at Alberta nurseries.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: There are cultivars but they are not suitable for reclamation (Dave's Garden n.d.).
Uses: Tree tops are used for interior decorating and branches are used for baskets, wreaths, birdcages, and decorative furniture (Marles et al. 2000). Trees have been cut for poles (Hardy BBT 1989).

Reclamation Potential

Exposure of mineral soil creates optimal seedbeds and accelerates alder's invasion of a site (Fryer 2011). River alder fixes atmospheric nitrogen, which in turn improves fertility and physical properties of soil (Hardy BBT 1989).

Notes

Alnus incana is listed as 90% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014). River alder sprouts rapidly from persistent root crowns following mild fires. Severe fires delay regeneration (Fryer 2011).
Alnus pollen may cause hay fever, or bronchial asthma, in some sensitive people (CYSIP: Botany n.d.).

Photo Credits

Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.
Photo 1: Simon Eugster. http://commons.wikimedia.org/wiki/File:Alnus_fruits.jpg
Photo 2: Wild Rose Consulting, Inc.

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Scientific Name: *Alnus viridis* ssp. *crispa* (Ait.) Turrill

Family: *Betulaceae*

Common Names: green alder, sitka alder, mountain alder, wavy-leaf alder, slide alder

Plant Description

Monoecious shrub, 1 to 3 m tall; fuzzy branches with pale lenticels, sticky when young; alternate leaves are irregularly toothed, ovoid, leathery, 2 to 8 cm long; inflorescence in catkins, male pendulous (5 to 8 cm), female woody and erect (1 to 1.5 cm) (Royer and Dickson 2007).

Fruit: Short-stalked seed cones, 1 to 2 cm long (Royer and Dickson 2007).

Seed: Samaras, smooth to rough texture, 3 mm x 1.5 mm (2 to 3 mm with wings), flat, oblong, light brown with papery translucent wings.

Habitat and Distribution

Habitat: Sand hills, open forests and edges of wetlands and streams. Semi-shade tolerant, but cannot grow with a dense overstory (Hardy BBT 1989, Matthews 1992).

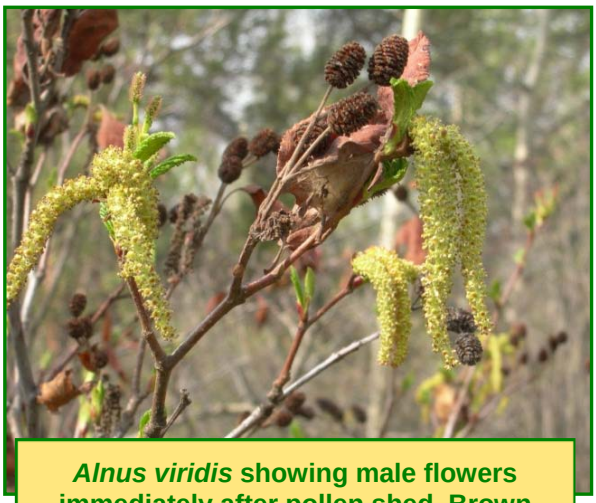
Seral Stage: Pioneer species, invading terraces above floodplains. Responds well to fire and resulting bare mineral soils (Hardy BBT 1989).

Soils: Coarse textures ranging from sandy to gravely/rocky; morainal deposits (Hardy BBT 1989).

Distribution: Boreal forest, aspen parkland, and Rocky Mountains foothills in Alberta. Alaska, Yukon, District of Mackenzie, Hudson Bay, Newfoundland south to northern California, Idaho, Montana, central Saskatchewan, Minnesota, Great Lakes; North Carolina (Moss 1983).

Phenology

Female plants mature in 5 to 10 years (Government of the Northwest Territories n.d.). Female catkins open at the same time as leaves in spring. Flowers in May and June, fruit matures in July, seeds ripen from late August to November. Abundant seed crops every four years (Government of the Northwest Territories n.d.).



***Alnus viridis* showing male flowers immediately after pollen shed. Brown cones are those that shed seeds last year and young female cones can be seen just opening.**

Pollination

Wind pollinated (Rook 2002).

Seed Dispersal

Wind dispersal (Rook 2002).

Genetics

2n=28 (Moss 1983).

Symbiosis

Green alder is ectomycorrhizal (Hagerman and Durall 2004). Inoculation of *Frankia* is rarely necessary as most soils contain abundant populations (Hendrickson et al. 1993). A single fungus is not associated with *Alnus*, but a seral succession of

mycorrhizal species follows both plant succession as well as aging of the dominant plants of a community (Sampo et al. 1997).

Seedling of *Alnus viridis* grown from directly sown seeds.

Seed Processing

Collection: Female catkins are easily stripped or snipped from low branches, or by bending branches to bring catkins within reach.
Seed Weight: 0.135 to 0.222 g/1,000 seeds (0.2 average).
Harvest Dates: Late August (WRC pers. comm.). Collect September 15 to October 15 (Formaniuk 2013).
Cleaning: Air-dry fruits in paper at 15 to 25°C. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from woody catkins using appropriate size screens. Small chaff and dust can be removed by winnowing.
Storage Behaviour: No literature found.
Storage: Store in sealed containers at cool temperatures (2 to 5°C) (Young and Young 1992).
Longevity: Seeds are viable for at least 2 years when stored dry at room temperature. 0% to 34% viability lost after 4 years hermetic storage at 2 to 4°C with 5.7% to 7.2% moisture content (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: Sprouts from root crown *in situ* (Rook 2002.
Germination: 10% to 20% germination in the first month with seeds from northeastern Alberta. Seed germinated after approximately 12 days, 28% of the seed germinated in temperatures of 30/20°C, low quality of seed is due to the possibility that the light weight of the seeds makes it more difficult to remove empty seed (Bonner and Karrfalt 2008). Fresh seed was found to exhibit some dormancy but no dormancy was found after 1 year in the soil (Bonner and Karrfalt 2008).
Pre-treatment: Cold stratification of 30 days. Wood (pers. comm.) suggests 21 day cold stratification before seeding; Formaniuk (2013) suggests 60 days stratification; Nichols (1934) suggests 60 to 90 days cold stratification.
Vegetative Propagation: Propagates by layering (Rook 2002). It also sprouts from the root crown if damaged or cut (Matthews 1992). They cannot be grown from cuttings (USDA NRCS n.d.).
Greenhouse Timeline: 20 weeks in the greenhouse before the seed can be out-planted. Plants can be over wintered for a spring or fall plant (Wood pers. comm.). Plant for 100 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Dry alder wood is burned to smoke salmon (Marles et al. 2000).
Medicinal: Stems can be boiled to treat upset stomachs. Roots can be used in a decoction to treat menstrual cramps. Inner bark decoction can be used as a wash for sore eyes and bark can be taken as a laxative (Marles et al. 2000).
Other: Bark and stem pieces, once chopped and boiled, make a red to brown dye for hides. Carved

tools and implements can be made out of alder wood. Peat moss burned with rotten alder wood can be used to smoke hides during tanning. Also, rotten wood can be burned to repel mosquitoes (Marles et al. 2000). Wood was burned as heat source where other fuels where scarce (Matthews 1992).

Wildlife/Forage Usage

Wildlife: Heavily browsed by moose and caribou in some areas; consumed in small quantities by deer; muskrat, beaver and cottontail. Snowshoe hares feed on twigs and foliage; birds feed on catkins, seeds, and buds; winter forage for white tailed ptarmigan (Matthews 1992).
Livestock: May be important as secondary forage for cattle (Matthews 1992).
Grazing Response: Resistant to grazing, regenerates from rhizomes and seed (Hardy BBT 1989).

Reclamation Potential

Increases soil organic matter through nitrogen fixation. Early serial species that invades disturbed site. Provides protection from wind and sun to young spruce trees (Hardy BBT 1989).
Alnus viridis also increases above ground biomass accumulation in *Pinus banksiana* stands (Vogel and Gower 1998).

Commercial Resources

Availability: Several Alberta nurseries carry propagules.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca Oil Sands Region.
Cultivars: None are known.
Uses: The treetops are used for interior decorating (the trunks and branches are used to produce natural to looking, semi to artificial trees with silk leaves), and the branches are used for baskets, wreaths, birdcages and decorative furniture (Marles et al. 2000).

Notes

Alnus viridis is listed as 97% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014). Can be a major competitor for conifer seedlings (Matthews 1992).

Photo Credits

Photos: Wild Rose Consulting, Inc.

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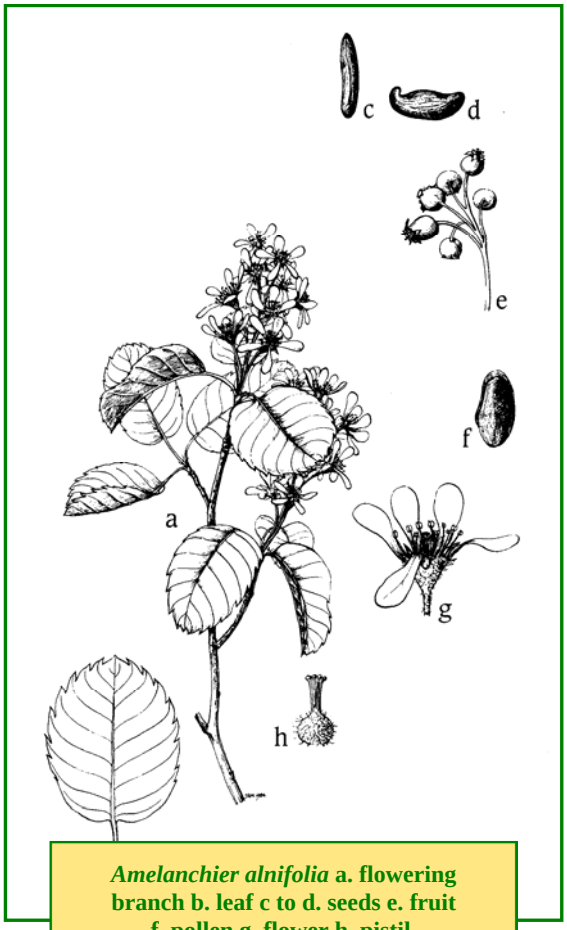
Scientific Name: *Amelanchier alnifolia* (Nutt.) **Family:** *Rosaceae*

Common Names: saskatoon, service berry, June berry, shadbush, shadblow, Indian pear, may cherry



***Amelanchier alnifolia* a. flowering branch b. leaf c to d. seeds e. fruit f. pollen g. flower h. pistil.**

Plant Description

Shrub, 1 to 6 m tall, smooth, grey or brown branches; alternate leaves, simple, hairy to smooth beneath, elliptical, coarsely toothed, turning red to red-purple before falling; erect dense fragrant raceme of 2 to 10 white flowers with five petals, terminal, 3 to 4 cm; 8 to 12 mm inflorescence; rhizomes underground (Moss 1983).

Fruit: Spherical pome, 6 to 15 mm, red-purple when ripe, edible, usually nine seeds per pome (Moss 1983).

Seed: 3 x 2 mm ovoid to kidney-shaped, little bumps on leathery surface, red-brown.

Habitat and Distribution

Open woodlands at lower elevations, mountain shrub lands, riparian areas, thickets, coulees or well drained areas (BC Ministry of Forests, Lands and Natural Resource Operations 2001). Prefers dry sites and good exposure to sun (Inkpen and Van Eyk n.d.)

Seral Stage: Typical of young seral forests. It is somewhat shade tolerant but will not tolerate a closed cover (Hardy BBT 1989).

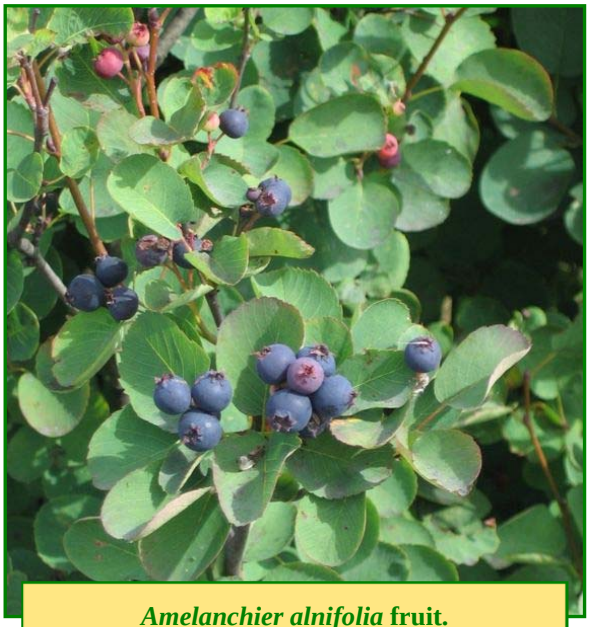
Soils: Prefers coarse, light textured, well drained soils with high organic matter.

Grows best at pH 6 to 7 but will tolerate pH from 5.5 to 7.5 (Hardy BBT 1989); from 4.8 to 8.4 (USDA NRCS n.d.).

Has a low salinity and drought tolerance (USDA

Flowering of *Amelanchier alnifolia*.

NRCS n.d.). Not found in places subject to annual flooding (Hale et al. 2005).
Distribution: Across Alberta; central Alaska, Yukon, District of Mackenzie to James Bay south to California, Arizona, New Mexico, Nebraska, Minnesota (Moss 1983).



***Amelanchier alnifolia* fruit.**

Phenology

Persistent flower buds develop in May, blooming from May to early June of the following year. Fruit ripens in July and seeds are mature at that time.

Pollination

Assisted by bees and other insects. Although self-pollinating, greater production seems to result from insect pollination (Fryer 1997).

Seed Dispersal

Birds and mammals (Fryer 1997).

Genetics

2n=34 (Moss 1983).

Seed Processing

Collection: Easy to strip clusters of berries from branches. Collect as soon as berries are ripe otherwise berries will be lost to wildlife (Bonner and Karrfalt 2008).
Seed Weight: 2.65 g/1,000 seeds.
Fruit/Seed Volume: 1,590 fruit/L average (14,300 seeds/L fruit).
Fruit/Seed Weight: 3,350 fruit/kg average (30,100 seeds/kg fruit).
Average Seeds/Fruit: 9 seeds/fruit.
Cleaning: Macerate in water, decant and screen then dry.
Harvest Dates: Late July and early August; July 1 to August 15 (Formaniuk 2013).
Storage Behaviour: Orthodox; store seed dried to low moisture content in hermetically-sealed containers at a low temperature, preferably -18ºC or cooler (Fassil and Engels 1997, Royal Botanic Gardens Kew 2008).
Storage: Store dry in containers at 5°C (Young and Young 1992). Hermetic air-dry storage at 5°C recommended; 76% germination following; viability maintained for 8 months in hermetic air-dry storage at 5°C (Royal Botanic Gardens Kew 2008).

***Amelanchier alnifolia* seeds (2 x 3 mm).**

Longevity: Seed remains viable for 5 to 7 years if kept at cool temperatures (Luna et al. 2008).
15 years open storage in a warehouse (Royal Botanic Gardens Kew 2008). 84% viability was maintained after 10 years of storage (Fryer 1997).

Propagation

Natural Regeneration: Reproduces by layering, sprout from the root crown, rhizomes and/or seed (Fryer 1997). It reproduces more often by vegetative processes than by seed with good seed crops only occurring every 3 to 5 years (Fryer 1997).
Germination: 80% germination within a month after 120 day cold stratification of fresh seed from north-eastern Alberta (Acharya et al. 1989). Seeds were germinated at a temperature of 21°C (McLean 1967).
Pre-treatment: Cold stratification 90 to 120 days at 3°C (Hudson and Carlson 1999, McLean 1967).
100 days in cold stratification (Wood pers. comm.).
Luna et al. (2008) recommended 120 days stratification after seeds are soaked in 3:1 water to 3% hydrogen peroxide and rinsed for 48 hr in water. They also suggest that seeds are washed in water weekly to eliminate all mucilaginous material.
There is some evidence that ingestion by bears lengthens the stratification period required to induce germination (Auger et al. 2002).
Success is influenced more by genetics as opposed to environmental conditions (Acharya et al. 1989).
Vegetative Propagation: Reproduces by rhizomes within 1.5 m of parent plant forming dense thickets (Inkpen and van Eyk n.d., Klinkenberg 2010).
Root cuttings and suckering as well as softwood cuttings may be used to propagate *A. alnifolia* (Hermesh and Cole 1983). Several inches of new growth when treated with 3,000 ppm IBA (Dirr and Heuser 1987).
Responds well to fire and mechanical disturbances (Fryer 1997).
Micro-propagation: Shoot tip explants (Dirr and Heuser 1987).
Greenhouse Production: Seed directly in 6:1:1 milled sphagnum/perlite/vermiculite/Osmocote controlled release fertilizer. Maintain greenhouse temperature at 21 to 25°C during the day and 16 to 18°C at night. Irrigate daily. Emergence is usually complete in three weeks (Luna et al. 2008).
Greenhouse Timeline: 16 weeks in the greenhouse till out planting. Can be stored overwinter for spring or September plant (Wood pers. comm.). Grow for 120 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Used as a sweetener and in making pemmican (Kindscher 1987, Marles et al. 2000). Can be dried and used as a substitute for raisins (Droppo 1987, Turner 1997). Dried berries can be added to soups (Northern Bushcraft n.d.).
Blackfoot would crush leaves, mix with blood and then dry and use to make a rich broth in winter (Kindscher 1987) or mix berries, fat and blood as a dessert (Royer and Dickinson 1996). Serviceberries contain more than three times the iron and copper as raisins (Kindscher 1987, Royer and Dickinson 1996, Wilkinson 1990).
Medicinal: Branches were used as an oil additive to treat lung problems, coughs, chest pain, muscle spasms, pinched nerves, diarrhoea (roots/stems), fever, flu and colds (Marles et al. 2000). Before ripening the berries can be used to help with diarrhoea but once ripened they can cause it if taken in excessive amounts (Gray 2011). Cheyenne would use leaves to make a medicinal tea (Kindscher 1987).
Other: Fruit is used to make a blue/purple dye (Royer and Dickinson 1996, Wilkinson 1990); wood is used for arrows, bows, lodge frames, canes, basket rims and drying racks (Marles et al. 2000). Roots were ground to make a tobacco substitute (Royer and Dickinson 1996).

Wildlife/Forage Usage

Wildlife: Important browse for ungulates (Hale et al. 2005). Bears, beaver, and hares also feed on various parts of the plant (Hardy BBT 1989, Fryer 1997). Fruit is eaten by bears, chipmunks, squirrels and birds (CYSIP: Botany n.d.).

Dense foliage provides excellent structure for breeding birds (Hale et al. 2005).
Livestock: Palatable to livestock. Most beneficial in spring for cattle, goats and sheep. Nutrient levels remain high throughout the year. Utilized more after mid-summer (Fryer 1997, Hardy BBT 1989).
Grazing Response: Decreaser (Hale et al. 2005), resistant to moderate browsing, leading to dense growth when inner foliage is not browsed. Continuous use will cause stands to decline (Fryer 1997, Hardy BBT 1989, Tannas 2003).

Reclamation Potential

In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that *A. alnifolia* invaded plots infrequently, but where they did become established they increased in abundance over time.
Saskatoon can be used in soil and slope stabilization as it spreads readily, and has a massive root crown, horizontal and vertical rhizomes and an extensive root system (Hale et al. 2005). Drought tolerance increases success without irrigation. Also effective at attracting wildlife, and with time may provide habitat for small mammals and birds (Fryer 1997, Hardy BBT 1989).
Amelanchier alnifolia also exhibits a conservative growth strategy that enables it to tolerate acidic conditions (Voeller et al. 1998) as well as found to naturally colonize soils contaminated with hydrocarbons (Robson 2003).

Commercial Resources

Availability: Widely available commercially as seed, seedlings, and small shrubs (ANPC 2010). Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: Numerous horticultural cultivars are known but none are suitable for reclamation purposes.
Harvest Methods: Shaking berries into hoppers or onto tarps below, especially in extensive stands and nurseries.
Uses: Commercially grown for jellies, jams, fruit and syrups.

Notes

A. alnifolia is listed as 82% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
A. alnifolia has a high fire tolerance, sprouting from the rhizomes and crown after fire (Fryer 1997).
So important were Saskatoons to the Interior (BC) Salish peoples that they developed a classification system for different varieties that is more detailed and complex than that of professional taxonomists (Turner 1997).
Pits contain cyanide-like toxins which are destroyed by cooking or drying (Northern Bushcraft n.d.).

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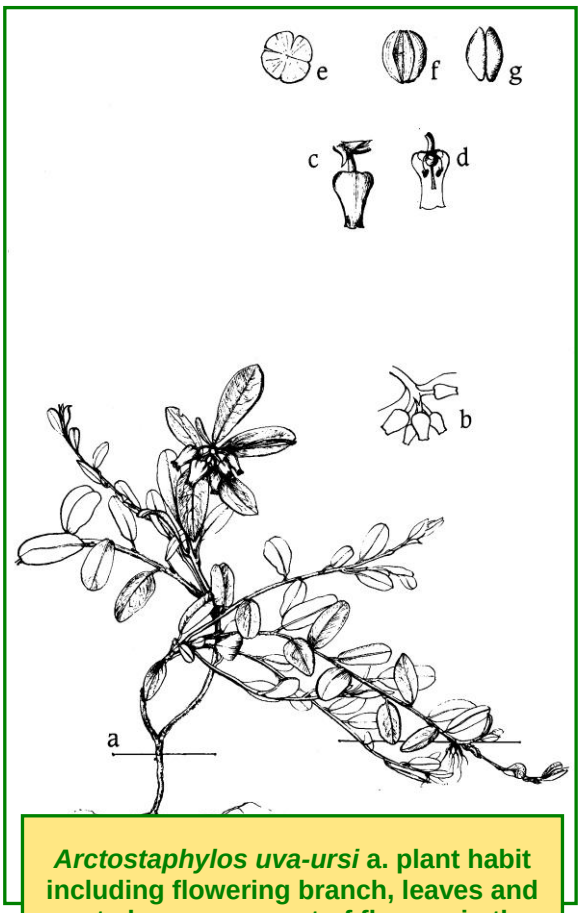
Scientific Name: *Arctostaphylos uva-ursi* (L.) Spreng**. Family:** Ericaceae

Common Names: bearberry, kinnikinnick, red bearberry, cowberry, manzanita, mealberry



***Arctostaphylos uva-ursi* a. plant habit including flowering branch, leaves and roots b. arrangement of flowers in the inflorescence c. flower d. flower (cut away) e – g. seed.**

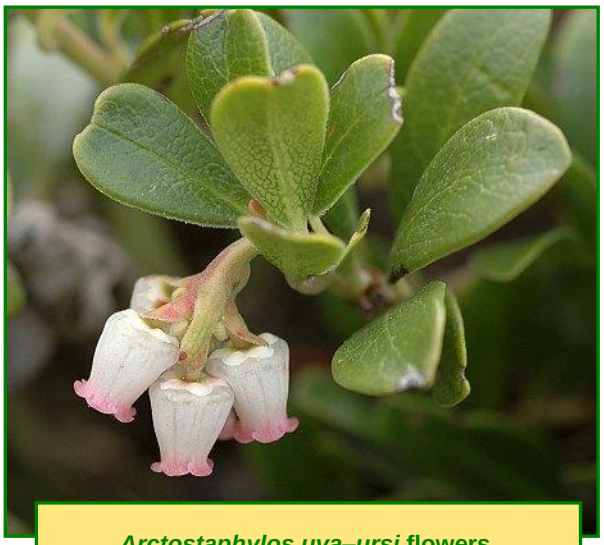
Plant Description

Trailing evergreen perennial shrub 7.5 to 10 cm tall; forms mats with prostrate and rooting branches 50 to 100 cm long; alternate leaves, coriaceous, obovate to spatulate 1 to 2 cm long; 1 to 3 cm long drooping urn-shaped flowers nodding in a dense raceme (3 to 10); rhizomatous with nodal feeder roots that form in the second years (Moss 1983). Roots up to 1 to 2 m deep (Nimlos et al. 1968).

Fruit: Mealy (not juicy) drupe with dry, shell-like skin; 6 to 8 mm diameter, spherical, dull red.
Seed: 5 to 6 seeds in a generally united round stone, individual 3.5 x 2 mm, sectioned, rough, porous, yellow brown.

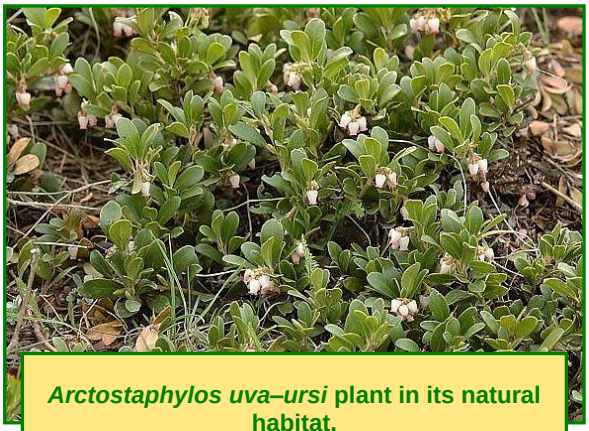
Habitat and Distribution

Prefers rocky, open woodlands, dry, sandy hills and pine forest (Lady Bird Johnson Wildflower Center 2013). It is adapted to coarse and medium textured soils; has moderate carbonate tolerance and is highly drought tolerant. Can handle pH from 5.5 to 8.0, medium salinity and prefers intermediate shade (USDA NRCS n.d.).
Seral Stage: Early, recovers well after fire (Crane 1991, Tannas 1997).
Soils: Sandy and well-drained sites in woodlands and throughout the prairie, roadside, exposed rocks. Relatively low shade tolerance. Moderate acid tolerance. Tolerant to a wide range of soil textures. Common on coarse and well drained soils. Preference to gravely and sandy loams (Hardy BBT 1989).



***Arctostaphylos uva–ursi* flowers.**

Drought tolerant and moderate tolerance to salinity, prefers pH ranges between 5.5 to 8 (Gerling et al. 1996, USDA NRCS n.d.).
Distribution: Widespread across Alberta, circumpolar. Alaska, Yukon, southwestern District of Mackenzie to Hudson Bay, Newfoundland south to California, New Mexico, South Dakota, North Dakota, Minnesota, Great Lakes, Virginia (Moss 1983).



***Arctostaphylos uva–ursi* plant in its natural habitat.**

Phenology

Flowers from April to June. Fruit ripens from June through September. Seeds are dispersed over the winter, August to March (Crane 1991).

Pollination

Hummingbirds occasionally take nectar from *Arctostaphylos uva-ursi* (Pojar 1975). It is also cross-pollinated by bees and can self-pollinate (Knuth 1909).

Genetics

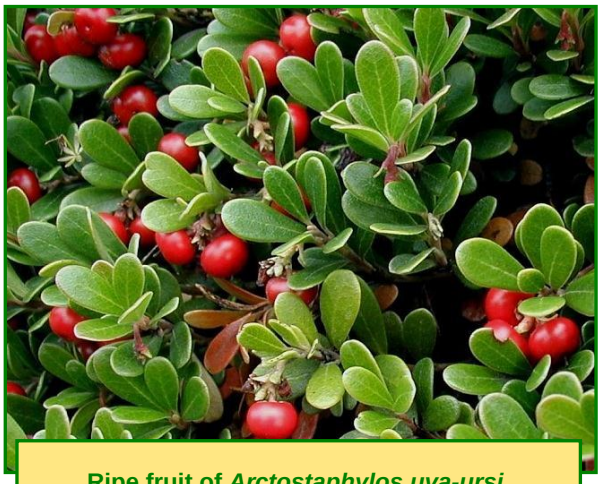
2n=26, 39, 52, 78 (Moss 1983).

Symbiosis

Both endotrophic tolypophagous mycorrhiza as well as ectotrophic *Cenococcum graniforme* occur in the wild and in plots (Gawlowska 1969). *Arctostaphylos uva-ursi* is also a host of the root endophytic fungus *Phialocephala fortinii* (Addy et al. 2000, Stoyke and Currah 1991). Arbutoid mycorrhizal inoculations (*Laccaria laccata)* increase root growth in hardwood cuttings (Scagel 2004). Host to *Melampsorella caryophyllacaerum* (Crane 1991).

Seed Processing

Collection: Low bushes make collection relatively difficult. Harvest by hand or using drop sheets or berry scoops.
Seed Weight: 6.31 g/1,000 seeds.
Fruit/Seed Volume: 1,694 fruit/L average (10,164 seeds/L fruit).
Fruit/Seed Weight: 3,720 fruit/kg average (22,320 seeds/kg fruit).
Average Seeds/fruit: 6 seeds/fruit.
Harvest Dates: Late August or September when fruit are bright red.
Cleaning: Mash fruit in a sieve or macerate with a blunt blender. Suspend residue in water, allowing seeds to settle. Decant water and chaff. Repeat as needed. Allow seeds to dry at room temperature in a moving air stream.
Storage Behaviour: Uncertain (Royal Botanic Gardens Kew 2008).
Storage: Store dry at cool temperatures.
Longevity: Seed can be stored up to 20 years at cool temperatures (Luna et al. 2008).



Ripe fruit of *Arctostaphylos uva-ursi.*

Propagation

Natural Regeneration: Seedlings recruit into adult clones (Eriksson 1989). Adventitious roots from the rhizomes or stolons form in the second year and latent buds (often many aggregated into a nodule-like structure) on horizontal stems allow plants to re-sprout especially in response to disturbances (Crane 1991).

Germination: 1% after two years, field emergence is better than *in vitro* germination (Smreciu et al. 2008). McLean (1967) obtained 34% germination after seed had been moistened and scarified in concentrated sulphuric acid for seven hours, kept at room temperature for 90 days, and finally, stratified at 1°C for 90 days.

Up to 60% germination was obtained using a combination of acid scarification (3 to 5 hours), cold stratification (3 to 4 months) and warm stratification (2 to 3 months) with seeds from north-eastern Alberta (Smreciu et al. 2006).

Optimal temperature for seed germination was found to be 10°C to 21°C depending on where the seed was collected (Baskin and Baskin 2001).

Pre-treatment: 1 hour in 5% sulphuric acid followed by 30 days cold stratification (Wood pers. comm.). Acid scarification from 3 to 6 hours followed by warm stratification (20 to 30ºC) of 60 to 120 days followed by 60 to 90 days cold stratification at 5ºC (Baskin and Baskin 2001, Smreciu et al. 2008, Young and Young 1992). This is supported by King (1980).

Direct Seeding: In an oil sands reclamation area in Fort McMurray, Smreciu et al. (2008) obtained 1% emergence after two years to 5% emergence after four years, seedlings are healthy and continue to thrive. Less than 1% emergence of seedlings from direct sowing of fruit was observed.

Seed Rate: 100 seeds/m², 25 fruit/m².

Planting Density: 700 to 4,400 plants/ha (USDA NRCS n.d.).

Vegetative Propagation: 80% rooting in 6 weeks was observed with semi-hardwood stem cuttings (10 to 20 cm) taken in May and treated with Stim–root 3® and placed on a mist bench under ambient greenhouse conditions (Smreciu et al. 2008). Hardwood cuttings and softwood cuttings 10 cm long initiate roots after approximately six weeks (Holloway and Zasada 1979). Herbaceous cuttings with hormone treatments were successful 93% of the time in Poland (Gawlowska 1969).

Greenhouse Timeline: 20 weeks in greenhouse prior to out-planting. Seedlings can be stored frozen overwinter for planting the following spring to fall (Wood pers. comm.).

***Arctostaphylos uva-ursi* stones comprised of approx. 6 seeds (left) and individual seeds (right). Seed 3.5 x 2 mm**

Aboriginal/Food Uses

Food: Cooked in lard, pounded and mixed with other foods or boiled and then fried in grease and sugar added (Marles et al. 2000). Dried berries can be ground and cooked into a porridge or can be popped when fried in grease (Northern Bushcraft n.d.). High in vitamin C and carbohydrates (Gray 2011, Royer and Dickinson 1996).

Not very good when eaten raw (mealy, insipid, tasteless) but quite nourishing (Droppo 1987, Northern Bushcraft n.d.). Flavour may vary by location (Turner 1997).

Medicinal: Fruits can relieve childhood diarrhoea; leaves can treat kidney and urinary tract disease (Royer and Dickinson 1996); roots can treat coughs and slows menstrual flow; stems can help prevent miscarriages (Marles et al. 2000); a tea made from

leaves was used as an astringent and diuretic (Royer and Dickinson 1996). The Cheyenne used as a poultice for back pain (Hart 1992).
A main constituent of bearberry is arbutin which acts as an antibacterial in the genitourinary tract (Gray 2011).
Other: Also used as a tobacco additive, extender or substitute (Marles et al. 2000, Royer and Dickinson 1996, Turner 1997). The tannins in the leaves create an ash-coloured dye that can be used for tanning hides (Gray 2011).

Wildlife/Forage Usage

Wildlife: Songbirds, game birds, deer, elk and small mammals eat the fruit. The fruit are especially important to black and grizzly bear in the early spring. Gray (2011) reports that bearberries have a numbing/paralyzing effect on the intestine. Many birds including ptarmigan and grouse eat the berries (CYSIP: Botany n.d.). Terrestrial birds and small mammals make moderate use of this pant for cover. Is also attractive to hummingbirds and butterflies (Crane 1991).
Livestock: Unpalatable to domestic livestock (Crane 1991).
Grazing Response: Tolerant to browsing; vigour and reproductive capacity are maintained (Tannas 1997).

Reclamation Potential

High drought tolerance, high winter hardiness, high persistence, and often found as a pioneer on disturbed sites (Hardy BBT 1989).
Arctostaphylos uva-ursi is recommended for revegetation projects on moist to dry sites in montane and boreal regions of Alberta. Very useful for erosion control because of formation of trailing mats.
Adaptable to soils low in nutrients. Excellent ground cover species used for watershed protection to prevent erosion and maximize the soil moisture absorption capacity (Tannas 1997).
Because of its moderate growth rate, bearberry is best suited as a long-term re-vegetative species (Crane 1991).
Uses intensive branching to adapt to soil toxicity and can spread roots to deeper less contaminated soils for improved growth (Salemaa and Sievänen 2002).

Commercial Resources

Availability: Available commercially in seed and plant form in Alberta and elsewhere.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: Several horticultural cultivars are commercially available but none are suited for reclamation.
Uses: Used as a diuretic herbal treatment. Prolonged use may cause stomach and liver problems (Northern Bushcraft n.d.).
It is also a popular ornamental ground cover for landscaping.

Notes

Arctostaphylos uva-ursi is listed as 94% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Bearberry increases in number following moderate disturbance. Its re-sprouting capacity is a rapid recovery mechanism after disturbances such as burning and cutting. Latent buds on the horizontal stems and dormant buds on the stem base allow sprouting of surviving plants or rooted stems (Crane 1991). Furthermore, its capacity to survive fire acts as a natural firebreak as it stops fire from spreading thus protecting the trees and shrubs around it (del Barrio et al. 1999).
This species listed as endangered in Illinois and Iowa, rare in Indiana and presumed extirpated in Ohio and Pennsylvania (USDA NCRS n.d.).
Kinnikinnick is a regulated plant and plant part for entering Canada by the CFIA due to its ability to carry Sudden Oak Death (*Phytophthora ramorum*) (CFIA 2009).
The fungus associated with witch's broom alternates between spruce and bearberry (Gray 2011).

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http://commons.wikimedia.org/wiki/Image:Arctostaphylos-uva-ursi.JPG
Photo 4: Wild Rose Consulting, Inc. Edmonton.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific name: *Betula nana* L. **Family:** *Betulaceae*

Common names: bog birch, arctic dwarf birch, swamp birch

Plant Description

A perennial, deciduous shrub, spreading or ascending to 3 m in height; bark, dark brown, smooth, close; lenticels pale, inconspicuous, unexpanded; twigs covered with large, warty, resinous glands; leaf blade is leathery, egg shaped to nearly circular with 2 to 6 pairs of lateral veins, 0.5 to 3 × 1 to 2.5 cm, teeth obtuse to rounded, surfaces, often covered with resinous glands; flowers are monoecious; preformed male catkins are 2.5 to 5 cm long, pendant, and become much longer and yellow-green as they open in mid-spring; females are upright, 2.5 to 5 cm long, and reddish green in color (eFloras n.d.).

Seed: Samaras with wings narrower than body, broadest near summit, extended slightly beyond body apically (eFloras n.d.).

***Betula nana* catkins**

Habitat and Distribution

Habitat: Arctic and alpine tundra, acidic rocky slopes and barrens, muskegs, peat bogs, stream banks, open subalpine summits.

Seral Stage: *Betula nana* has been found in a wide distribution of successional communities (Tollefson 2007).

Soil: Plants are adapted to a wide range of soil textures and do well in acidic (pH 4.9 to 6.5) and nutrient poor soil, but has no tolerance to salinity (USDA NRCS n.d.).

Distribution: 0 to 3,400 m (Tollefson 2007).

Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland., Northwest Territories, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon; Alaska, California, Colorado, Idaho, Maine, Mont., New Hampshire, New York, Oregon, South Dakota, Utah, Washington, Wyoming (eFloras n.d.).

Alaska, Yukon to southern Baffin Island south to California, Nevada, Colorado, central Saskatchewan, central Manitoba, Great Lakes, Newfoundland (Moss 1983).

Phenology

Leaves appear in April to May (TLF 2012).

Flowers from June to August, fruit ripens August to

***Betula nana* with developing catkins**

October, and seed are dispersed September through March (Young and Young 1992).

Pollination

Flowers are pollinated by wind (TLF 2012). *Betula nana* flowers are not self-pollinating (de Groot et al. 1997).

Seed Dispersal

Light, winged seed are wind dispersed, with some water dispersal.

Genetics

2n=28 (eFloras n.d.).

Symbiosis

Betula is ectomycorrhizal (Treu et al. 1996).

***Betula nana* seeds**

Seed Processing

Collection: Birch seed is collected by picking the catkins while they are still green enough to hold together. They shatter easily and should be put directly into bags (Lady Bird Johnson Wildflower Center 2009).

Seed Weight: 0.83 g /1,000 seeds (Kew Royal Botanic Gardens 2012); 272,000 seeds/kg (3.68 g/1,000 seeds) (USDA NRCS n.d.).

Harvest Dates: End of August to October (Young and Young 1992).

Cleaning: Air-dry fruits/cones at 15 to 25°C. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens (8/64 inch screen size (Young and Young 1992).

Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).

Storage: Store at cool temperatures (2 to 5°C) at 1% to 3% moisture (Young and Young 1992).

Longevity: Seed was shown to store up to six years at 5°C (Forbes and Beardmore 2009).

Propagation

Natural Regeneration: Dwarf birch reproduces primarily vegetatively by layering and by sprouting from the root crown and/or rhizomes after fire and other top-killing disturbances (Ebersole 1987).

Germination: Seed germination from 21% to 95% at an optimum temperature of 15 to 30°C (Tollefson 2007).

Dormancy of *B. nana* at low germination temperature (12°C) can be broken by moist stratification in darkness at 2 to 3°C for 5 to 15 days, or by application of gibberellic acid (up to 1,000 mg/L) to achieve germination rates greater than 90% (de Groot et al. 1997).

Pre-treatment: In Junttila's (1970) research, cold stratification from 5 to 15 days at temperatures of 2 to 3°C combined with light treatment and gibberellic acid effectively broke dormancy. Baskin and Baskin (2002) recommend placing seeds in cold moist stratification for 14 days. Germination occurs at 24°C.

In a greenhouse experiment, stratification for 5 to 15 days broke seed dormancy in dwarf birch. Stratification for 15 days was required for maximum germination in 14 days at 12°C (Tollefson 2007). A longer period of stratification was required for maximum germination at lower temperatures (Tollefson 2007).

Planting Density: 3,000 to 4,200 plants per hectare (USDA NRCS n.d.).
Direct Seeding: Although *B. nana* produces abundant seed and seed viability may be as high as 95%, successful establishment from seed is rare. Dwarf birch seedlings are slow growing (Tollefson 2007).
Vegetative Propagation: *B. nana* has the possibly of being propagated by layering and by rhizome cuttings.

Aboriginal/Food Uses

The young leaves can be added to salads for flavoring. The Chippewa made tea of *Betula nana* for relieve of stomach ache. Bark sap is also sweet and can be used as a sweetener or boiled down to syrup (Lahring 2003).

Wildlife/Forage Usage

Wildlife: *Betula nana* is a very important food species for wildlife. Deer, elk, moose, hare, porcupine and beaver browse heavily on the foliage and twigs, often keeping plants stunted.
Seeds are eaten by many kinds of birds, squirrels and wood rats (Lahring 2003).

Reclamation Potential

Betula nana is susceptible to many human activities; it does not do well in compacted soils or in oil contaminated soils (Tollefson 2007).
It has potential for controlling soil erosion (Tollefson 2007).

Commercial Resources

Availability: Available as seed in Alberta (ANPC 2010). Produced commercially by bare root, container and by seed (USDA NRCS n.d.).

Notes

Betula glandulosa was once taxonomically separate from *Betula nana* (de Groot *et al.* 1997); they are now combined into one species *Betula nana* according ITIS (n.d.).

Wick et al. (2008) grew 40 cm tall *Betula glandulosa* seedlings in 3 L containers in 16 months under greenhouse conditions.
Stressed plants are subject to attack by the bronze birch borer (*Agrilus anxius* Gory) although paper birch is more susceptible (Cerezke 1994).

Photo Credits

Photo 1: Courtesy of the Smithsonian Institution.
Photo 2: Courtesy of the UDSA website and Steve Hurst.

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Scientific Name: *Cornus sericea* ssp. *sericea* L. **Family:** *Cornaceae*

Common Names: red-osier dogwood, dogwood, red willow

***Cornus sericea* ssp. *sericea* a. branch with inflorescence. b. fruit. c. individual flower. d-e. seeds.**

Plant Description

Deciduous, perennial, upright shrub, 1 to 3 m high, with spreading rhizomes; lower branches often prostrate; deep-red (green-purple) pubescent twigs; oval to ovate-lanceolate leaves 2 to 6 cm long, glaucous beneath; flat-topped terminal clusters of many white flowers with 2 to 3 mm long petals (Moss 1983).

Fruit: White round drupe, succulent, 6 to 8 mm in diameter (Banerjee et al. 2001).

Seed: 3.5 to 5 mm oval stone, 1 to 2 embryos, grey to deep brown with pale striations, smooth.

Habitat and Distribution

Common in moist woods, ponds, riverbanks, thickets, clearings and coulees throughout the Canadian prairies (Moss 1983). Also, found in river flood plains.

Seral Stage: Early to late seral species.

Soil: Found on well drained to poorly drained soils. Most successful on free draining soils with adequate moisture availability. Tolerant of a wide range of pH values (3.2 to 8.0), preference for nutrient rich sites (Smithberg 1974). In a greenhouse study, Mustard and Renault (2006) found that NaCl reduced shoot dry mass and height.

Distribution: Widespread across Alberta (boreal forest, aspen parkland and Rocky Mountains). Alaska, Yukon, western District of Mackenzie to James Bay, Newfoundland south to California, Arizona, New Mexico, Nebraska, Ohio, West Virginia, Pennsylvania (Moss 1983).

Phenology

Flowers April to August (September). Fruit ripens from mid-July to mid-October in north-eastern Alberta. Fruit bearing at 3 to 4 years of age (Rook 2002).

Pollination

Cross-pollinated by *Andrena, Apis* and *Bombus* spp. (Gunatilleke and Gunatilleke 1984), some beetles, flies and butterflies (Eyde 1988).

Seed Dispersal

Used for food by white-tailed deer, mule deer, elk, mountain goats, cottontail rabbits, snowshoe hares, and numerous birds (Gucker 2012) and black bears and beavers (Smithberg 1974), all of which may disperse seed.

Genetics

2n=22 (Moss 1983).

Symbiosis

Endomycorrhizal inoculation with *Glomus fasciculatum and Glomus macrocarpum* during propagation significantly increases the growth of the plant during later stages of development (Verkade et al. 1988).

***Cornus sericea* berries.**

Seed Processing

Collection: Berries are easily shaken or picked from taller bushes or trees. Large clumps make collection particularly easy. Seeds should not be picked from isolated plants to avoid the risk of self-sterile seed or empty fruit collection (Young and Young 1992).
Seed Weight: 24.7 to 28.6 g/1,000 seeds (27.0 average).
Fruit/Seed Volume: 2,050 to 2,890 fruit/L (2,460 average), 2,460 seeds/L fruit.
Fruit/Seed Weight: 4,520 to 5,470 fruit/kg (4,900 average).
4,900 seeds/kg fruit.
Average Seeds/Fruit: 1 seed/fruit (occasionally with 2 embryos).
Harvest Dates: Collect in late July to late August in north-eastern Alberta; September 1 to September 30 (Formaniuk 2013). Harvest as soon as fruits are ripe (snowy white to blue tinged) (Banerjee et al. 2001).
Cleaning: Mash fruit in a sieve (1.40 mm works well). A blender with taped blades may also be used to macerate the fruit. Suspend residue in water allowing seeds to settle. Decant water and chaff. Repeat suspension and decanting until only seeds remain. Allow seed to dry at room temperature.
Storage: Store dry in sealed containers at cool temperatures (3 to 5°C) (Roof 2008, Young and Young 1992).
Longevity: 4 to 8 years when stored in sealed glass containers at 1 to 3°C (Harrington et al. 1999, Smithberg 1974).

Propagation

Natural Regeneration: Both by seed and vegetative means (new shoots from roots and prostrate branches) (Gucker 2012). Will produce stolons in very moist soil. Reproduces from sprouts and root shoots (Hardy BBT 1989, Smithberg 1974).
Germination: 11% in 30 days from 1 or 2 year old seeds harvested in north-eastern Alberta.
Pre-treatment: McTavish and Shopik (1983) recommend 60 to 90 days cold stratification at 1°C. Needs 60 days cold stratification (Wood pers. comm.). Both Nichols (1934) and Young and Young (1992) recommend 2 to 3 months cold stratification at 3 to 5°C. Formaniuk (2013) recommends 120 days stratification.
Seeds may be stored at cold temperatures for a month and then stratified for a month using light dark cycles during incubation (Acharya et al. 1991). The short warm stratification period can be replaced with mechanical scarification or by bathing the seeds in sulphuric acid (Roof 2008).
Direct Seeding: Less than 1% emergence from seeds sown in north-eastern Alberta. Sowing intact fruit results in numerous robust seedlings (> 7% emergence for fall sown fruit). Fruit should be

sown immediately after harvest. Sow seeds using drills and occasionally broadcast (Roof 2008). If using frozen stored berries, fall sowing resulted in slightly better emergence than spring sowing. Young seedlings are drought intolerant.

Seeds sown in a nursery should be at a soil depth of 0.6 to 1.25 cm (0.25 to 0.5 in) (Roof 2008). Beds sown in the fall should be mulched during the winter (Roof 2008).

Seeding Rate: 100 seeds/m² and 50 fruits/m² to obtain 1 to 4 plants/m².

Vegetative Propagation: Hardwood pole cuttings placed directly are often successful (Smreciu and Barron 1997). Can establish from softwood stem and root cuttings in high moisture conditions (Hartmann et al 1990, Tannas 1997). 80% rooting using hardwood cutting with seradix #2 treatment in a mixture of 1:1:1 peat/sand/reground styrofoam chips with 16 °C bench heat (McTavish and Shopik 1983). Meilleur et al. (1997) report larger crown diameters 3 years after layering.

Root cuttings from early August were found to be 100% rooted within 5 weeks, while those cut mid-April were 90% rooted within 8 weeks (Gucker 2012).

French layering and/or division are also effective (Roof 2008).

Can be grown as a bare-root, containerized, or balled and burlapped plant (Pijut 2004).

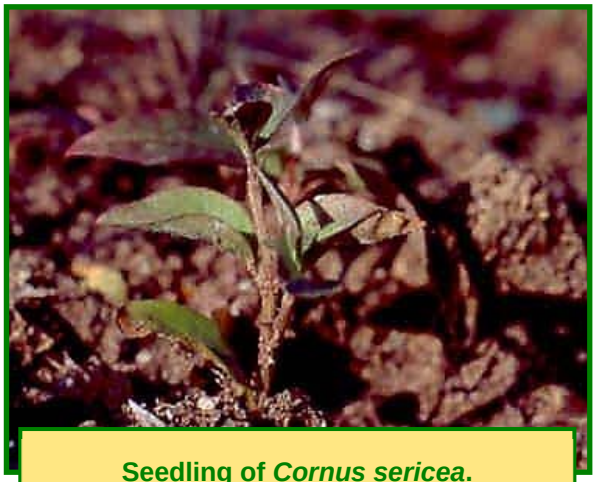
Greenhouse Timeline: 12 weeks in greenhouse before out planting. Dormant seedlings can be stored frozen overwinter for spring or early fall planting (Wood pers. comm.). Grow for 90 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Some tribes mix the berries with other sweeter berries (Turner 1997).

Medicinal: Tea made from roots is used to treat dizziness; tea from stems is used to relieve chest trouble, as an emetic, or for coughs and fevers. A decoction made from the bark is used as a laxative. Peeled bark mixed with other plants and boiled can treat sore eyes. A wash, made of fruit or stem pith, is used to treat snow blindness or cataracts. A decoction made from ripe fruit can treat tuberculosis. A decoction made of roots mixed with other herbs is used to treat diarrhoea in children (Marles et al. 2000).

Other: Thicker stems can be used to make ribs for spruce bark canoes (Marles et al. 2000). Has been used by the First Nations people to make dream catchers, dye, baskets, tanning hides as well as arrows and other tools. They also used *C. sericea* as a toothbrush because the twigs can whiten teeth. Various native cultures have used the inner bark of *C. sericea* in the tobacco mixture for smoking the sacred pipe (Turner 1997, USDA NRCS n.d.).



Seedling of *Cornus sericea*.

Wildlife/Forage Uses

Wildlife: One of the most valuable browse species in Alberta (Tannas 1997) especially for moose. Used for food and cover by white-tailed deer, mule deer (heavy summer use) elk, mountain goats, cottontail rabbits, snowshoe hares, and numerous birds (Gucker 2012) including ruffed grouse (Hardy BBT 1989). Berries are also eaten by black bears and beavers (Smithberg 1974).

Livestock: Mature leaves are relatively unpalatable to livestock however, the young sprouts are palatable. It is not a preferred species for livestock browse (Gucker 2012).

Grazing Response: Resistant to heavy browsing (Tannas 1997). Extensive deer browsing increases branching and fruit/seed production on reclaimed sites (Smreciu and Barron 1997).

Reclamation Potential

High tolerance for oil and high salinity oil sands tailings water (Hardy BBT 1989, Renault et al. 1999).
Grows successfully (from container seedlings) on various reclamation sites (Fedkenheuer et al. 1980, Fung 1984, Smreciu and Barron 1997).
Dogwood has a high tolerance to sodium and sulphate enriched consolidated tailings water (Renault et al. 1998).
C. sericea is a prolific seed producer (Smreciu and Barron 1997).
Useful in stabilization of eroding stream banks. Rooting from cuttings may accelerate this stabilization. Rapid growth and easy establishment of seedlings and transplants make it an ideal reclamation species.

Commercial Resources

Availability: Produced commercially by several Alberta and Saskatchewan nurseries. Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: Numerous horticultural cultivars are available but these are not suitable for reclamation.
Uses: As an ornamental shrub, and dried or preserved floral product (Marles et al. 2000). Common for windbreaks and border plantings (Smithberg 1974).

Notes

C. sericea is listed as 89% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Red-osier dogwood is able to tolerate extremely cold temperatures, and flooding. It is a semi fire-tolerant, seed banking species that generally increases in abundance following a fire (Gucker 2012).
Synonym: *Cornus stolonifera* (Pijut 2004, Rook 2002).

Photo Credits

Photos: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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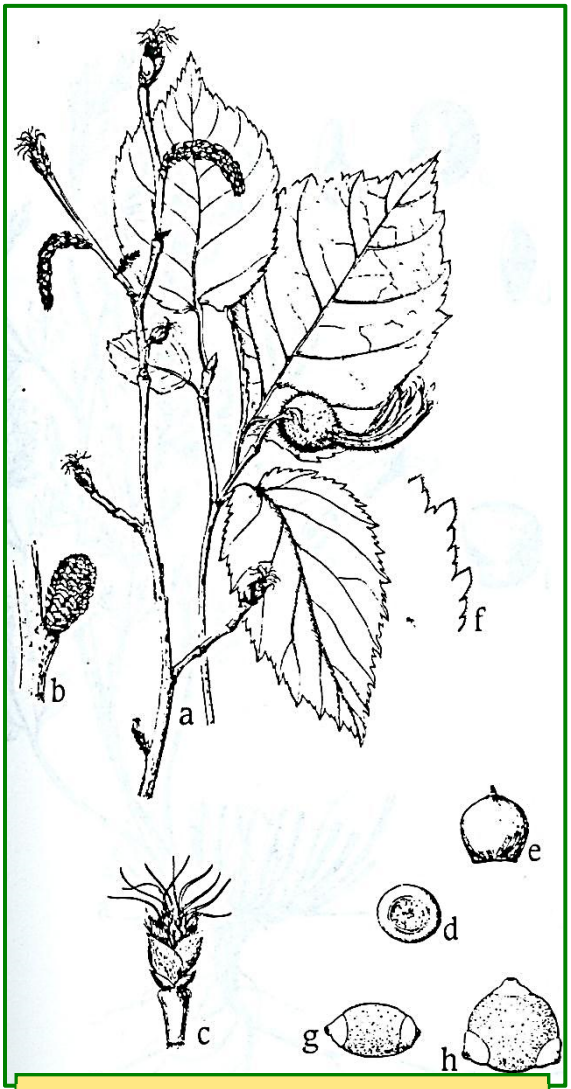
Scientific Name: *Corylus cornuta* Marsh. **Family:** *Betulaceae*

Common Name: beaked hazel, beaked hazelnut, western hazel, wild filbert, beaked filbert



***Corylus cornuta* illustration**
a. branches with female and male flowers b. leaves and fruit c. female flower d-e. nut f. leaf margin g-h. pollen

Plant Description

Shrub up to 3 m tall, branches numerous and ascending; bark smooth, mottled brown and grey, may have fine hairs on twigs (eFloras n.d.). Leaves are alternate, deciduous, pale beneath, oval, 5 to 10 cm long, 2.5 cm wide; flowers in catkins appearing before the leaves, base heart-shaped; stalks 8 to 18 mm long; margins coarsely toothed; male catkins are yellowish brown, 1 to 2; female catkins resembling a scaly bud with 2 to 5 reddish pink pistils; flowers of beaked hazelnut are predominantly monoecious, male flowers with 4 stamens; female flowers with one pistil (Royer and Dickson 2007).
Fruit: Nuts borne in clusters of 2 to 6; bract flask-shaped, bristly, green which extend beyond nut to form a beak (Inkpen and Van Eyk n.d.). 1 to 5 cm long (Royer and Dickson 2007).
Seed: Spherical brown nut, 1 to 2 cm diameter.

***Corylus cornuta* female flower**

Habitat and Distribution

Thickets, open woods and landscapes disturbed by fire and logging; moderately shade tolerant (Fryer 2007, Inkpen and Van Eyk n.d., Moss 1983).
Do not do well in open areas that get hot and dry.
Seral Stage: Mainly early successional species, hazelnut can also be found in forests that are in later stages of succession (Fryer 2007). Populations

decline with the recruitment of more shade tolerant species as the canopy closes (Kurmis and Sucoff 1989).

Soils: Neutral to acidic (Fryer 2007, Lady Bird Johnson Wildflower Center 2010) with a pH range of 4.8 to 7.5 (USDA NRCS n.d.). Moisture regime is wet-mesic to dry-mesic and does not grow well on fine-textured clays or wet soils such as peats (Fryer 2007). *C. cornuta* has no salinity tolerance (USDA NRCS n.d.).

Distribution: British Columbia across southern Canada to Newfoundland south to California, Kansas, Ohio, Georgia (Moss 1983).

***Corylus cornuta* with nut cluster.**

Phenology

Male and female flowers are borne on separate branches of the same plant, male and female flowers bloom from April to early May, before leaves appear (Barbour and Brinkman 2008, Royer and Dickson 2007). By late summer or early fall, the fertilized female flowers develop into fruits. These are round or egg-shaped, hard-shelled, brown or dark-tan nuts, seed crops are produced at irregular intervals, usually every two or three years (Barbour and Brinkman 2008).

Pollination

Wind pollinated, self-incompatible in laboratory study (Fryer 2007).

Seed Dispersal

Animal dispersed; squirrels, chipmunks, ruffed grouse, pheasant, hairy woodpecker and blue jay eat the nuts of the shrub (Lady Bird Johnson Wildflower Center 2010).

Genetics

2n=28 (Moss 1983).

Symbiosis

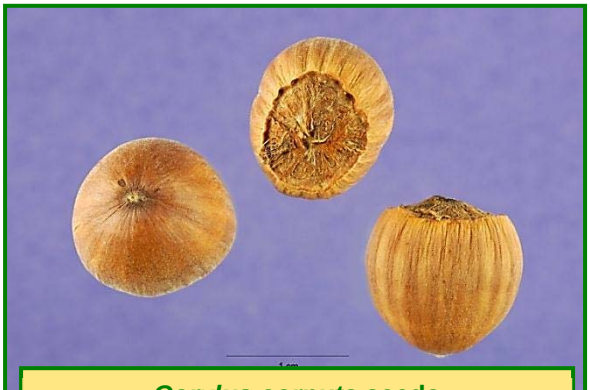
Corylus avellana is associated with ectomycorrhiza, such as *Tuber nigrum* (a truffle) (Pargney and Brimont 1995).

Seed Processing

Collection: Hand collect nuts promptly when husks start to turn brown to reduce losses due to wildlife browsing. Store nuts in a dry place for a few days and remove the husks (Rook 2002).

Seed Weight: 1.2 seeds/g or 833 g/1,000 seeds (Young and Young 1992).

Harvest Dates: August to September (Young and Young 1992).



***Corylus cornuta* seeds**

Cleaning: Small lots seeds can be cleaned by rubbing the seeds together by hand using gloves removing the outer husk of the seed (Barner 2009).

Storage Behavior: Thought to be intermediate (Royal Botanic Gardens Kew 2008).
Storage: Seeds lose viability when stored in dry conditions; due to an onset of a deep dormancy which is difficult to break (Young and Young 1992); storing the seeds in moist conditions will prevent this (Barbour and Brinkman 2008, Young and Young 1992). Even partial drying reduces post chilling germination (Kowalski and Kowecki 1982).
Seeds can be stored in hermetic storage at 5°C; no loss in viability after 14 months dry storage; dry and viable seeds were killed by cryostorage in liquid nitrogen (Royal Botanic Gardens Kew 2008).
Longevity: Not viable after 1 year (Fryer 2007).

Propagation

Natural Regeneration: By seed and vegetatively. Vegetative reproduction is more common (Haeussler et al. 1990) but seed production is important for establishment on new sites (Tappeiner 1971). Kurmis and Sucoff (1989) found that hazelnut distribution is maintained by recruiting new stems.
Germination: Germination rates are low even following pre-treatment (Rook 2002).
Pre-treatment: 2 to 6 months of cold stratification is required for germination (Rook 2002, Young and Young 1992).
Direct Seeding: Preferred method of *Corylus cornuta* propagation. Most nurseries plant in the fall. Seeds are planted 2.5 cm deep and covered with 2.5 to 3 cm of sawdust (Young and Young 1992).
Seeding Rate: Seedling densities are kept low; 42 to 63 per m^2 (Young and Young 1992).
Vegetative Propagation: Grow well from transplant root suckers from larger plants or layering (Lady Bird Johnson Wildflower Center 2010, Leigh 1999, Rook 2002).
Hardwood cuttings had a 60% success rate, hardwood cuttings are not recommended for direct placement and may be more successful with greenhouse assistance, more study required (Darris 2002).

Seed Dispersal

The seeds are rich in protein and a desirable food source to many birds and animals. *Corylus cornuta* plants rely on forgotten rodent and bird seed cashes (e.g., blue jay and red squirrel) for dispersal and seeding establishment (Lady Bird Johnson Wildflower Center 2010).

Aboriginal/Food Uses

Food: Hazelnut seeds are edible once the persistent sheaths and shells are removed (Wilkinson 1990).
BC Aboriginal peoples buried the nuts for 10 days to allow the husks to rot away (Turner 1997). A simpler method was to find nuts already de-husked in squirrels nests (Turner 1997).
They can be roasted, candied or added to other foods. They can also be made into oil (Mackinnon et al. 2009) or ground into flour (Wilkinson 1990).
At one time the Cree collected and stored these nuts which they call *pakan* (Royer and Dickinson 1996).
Medicinal: An infusion of *Corylus cornuta* branches was made as a blood purifier to treat heart problems and gastrointestinal disorders (Mackinnon et al. 2009).
Nut's milk is used to cure cough and colds, heal cuts (USDA NRCS n.d.).
Other: Used to fashion a bow, wood was used to make tools, fish traps and baby carriers (Mackinnon et al. 2009, NPSBC n.d.). Young, straight suckers used to make arrows, and peeled and twisted to make ropes (Wilkinson 1990).
The roots and inner bark produce a blue dye when steeped in water (Wilkinson 1990).

Wildlife/Forage Use

Wildlife: Squirrels, chipmunks, bear, ruffed grouse, pheasant, hairy woodpecker and blue jay eat the nuts of the shrub (Wilkinson 1990). Snowshoe hare browse on young shoots during the winter. The winter buds and spring catkins are a valuable protein source for ruffed grouse during the winter (Lady Bird Johnson Wildflower Center 2010). Elk, deer, moose and rabbits browse on the shrub in the winter (Fryer 2007, Royer and Dickinson 1996).

The dense branches provide cover and nesting sites for birds (Wilkinson 1990).
Grazing response: Tolerant to browsing (Fryer 2007).

Commercial Resources

Availability: Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: Cultivars such as the variety "Alba" are available; however none are suitable for reclamation (Rook 2002).

Notes

Corylus cornuta is listed as 60% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Corylus cornuta is an important larval host for the Hairstreaks butterflies *Erora laeta.* The butterfly lays its eggs on the underside of the host's leaves and the larvae eat the nuts and leaves of the host (Opler n.d.).
Also known as cobnut in British Columbia (Turner 1997).

Photo Credits

Photo 1: Fungus Guy, Wikimedia Commons 2004.
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Photo 3: Steve Hurst, USDA. Public Domain. Wikimedia commons 2006.

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Scientific name: *Dasiphora fruiticosa* (L.) Rybd., comb. nov. ined.
Family: *Rosaceae*

Common Names: shrubby cinquefoil

Plant Description

Freely branched shrub, spreading to erect, 20 to 100 cm high, reddish-brown stems with shredded outer bark; short-petioles, pinnate leaves with mostly five linear-oblong, entire, slightly hairy leaflets; yellow flowers 2 to 3 cm across, solitary or cymose; thin woody roots and adventitious stems (Elkington and Woodell 1963).

Fruit: Achenes, densely hairy in compact clusters.

Seed: 1 to 1.5 mm long, tear-shaped, green-yellow to brown, smooth to rough textured. 18 to 70 per flower (Elkington and Woodell 1963).

Habitat and Distribution

Found on moist to dry plains and in open woods to subalpine elevations. Found along stream banks and swamps in the boreal forests of northern Alberta and are somewhat shade tolerant (Hardy BBT 1989).

Seral Stage: Early to late (Gerling et al. 1996).

Soils: Adapted to a wide range of soil conditions from fine to coarse, can tolerate a wide pH range 5 to 8 (USDA NRCS 2012). Grows well on sandy and loamy soils. High acid tolerance, including pH lower than 4.5 (Hardy BBT 1989).

D. fruiticosa is moderately tolerant to saline soil conditions (USDA NRCS n.d.).

Distribution: Widespread from Alaska across Canada and the western and northern USA. Circumpolar with large gaps (Johnson et al. 1995).

Circumpolar; Alaska, Yukon, District of Mackenzie to Hudson Bay, Newfoundland south to California, Nevada, Utah, New Mexico, South Dakota, Minnesota, Indiana, Pennsylvania, New Jersey (Moss 1983).

Phenology

Germination normally occurs in spring. Maximum root growth occurs late spring and summer (Elkington and Woodell 1963). Flower buds appear May to June. Shrubby cinquefoil flowers from June to September. The fruit matures in late summer and early fall.

Plants have been found to live up to 36 years (Anderson 2001).

***Dasiphora fruticosa* flower.**

***Dasiphora fruticosa* seed. Seeds are generally 1 to 1.5 mm long.**

Pollination

Diptera, Cleoptera and Hymenoptera have been observed as shrubby cinquefoil pollinators (Elkington and Woodell 1963).

Seed Dispersal

Wind dispersed (Anderson 2001).

Genetics

2n=14, 28 (Moss 1983).

Symbiosis

In their study, Van Hoewyk et al. (2001) found a high endomycorrhizal colonization rate (average 78% of all root segments) of *D. fruticosa* on eight different calcareous wetlands in eastern New York. Colonized by arbuscular mycorrhizal fungi (Bohrer et al. 2004).

Seed Processing

Collection: Cut flowering branches and place in paper bags or shake branches into bags or onto tarps.
Seed Weight: 0.1808 g/1,000 seeds.
Harvest Dates: Late August.
Cleaning: Air-dry fruits in paper or Tyvek bags at 15 to 25°C. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing. If capsules are intact merely open capsules and empty seeds; sieve or winnow to remove chaff and dust.
Storage: Keep in a well-ventilated drying shed prior to cleaning.
Longevity: Stored at -18°C, seeds can germinate after up to seven years in storage (Walsh et al. 2003). When stored dry at 1 to 5°C, seeds can remain viable for up to 5 years (Rose et al. 1998).

Propagation

Natural Regeneration: Creeping stems but predominantly seed (Elkington and Woodell 1963).
Germination: 53% from fresh seeds after 30 days and 61% from one-year-old seeds after 30 days with seeds collected in northeastern Alberta.
Seeds germinated at 18°C (Baskin and Baskin 2001).
Pre-treatment: Requires no stratification (Baskin and Baskin 2001).
Direct Seeding: Seeds should be planted as soon as ripe on moist soil (Hardy BBT 1989).
Vegetative Propagation: 75% to 80% rooting using hardwood cuttings treated with Seradix© #3 and placed in a mixture of 1 peat: 1 sand: 1 reground styrofoam chips with 16°C bench heat. 80% to 90% rooting using softwood cutting treated with Seradix© #2 with periodic misting until rooting takes place (McTavish and Shopik 1983). Softwood cuttings taken in July, dipped in 1,000 ppm IBA and planted in peat: perlite or sand medium and misted will root in about three weeks (Rose et al. 1998).
Micro-propagation: Is commercially micro-propagated for ornamental purposes.

Greenhouse Timeline: 0 to 30 days cold stratification. 16 weeks in the greenhouse before out-planting. Plants may be over wintered for a spring or fall plant (Wood pers. comm.).

Aboriginal/Food Uses

Food: Dried or fresh leaves can be brewed into a golden coloured tea (Johnson et al. 1995) that is high in calcium (Kindscher 1987).
Medicinal: A tea from the leaves, stems and roots has been used to treat congestion such as tuberculosis (Johnson et al. 1995).
Other: The dried bark peels off the stem and can be used as tinder for starting fires (Johnson et al. 1995).

Wildlife/Forage Usage

Wildlife: Good forage value for wildlife (Gerling et al. 1996).
Livestock: Poor forage value for livestock (Gerling et al. 1996).
Grazing Response: This species increases with increased grazing (Tannas 1997).

Reclamation Potential

Proven successful in revegetating mining disturbed lands. Good potential for growth and survival on amended mine tailings. Rapid growth, easy establishment from transplants and excellent soil stabilizing properties makes this species well adapted for revegetation of disturbed stream banks and moist meadow areas. High potential for biomass production, moderate potential for erosion control, moderate to high potential for long term revegetation (Anderson 2001).

Commercial Resources

Availability: Available at numerous nurseries in Alberta.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.

Cultivars: Many ornamental cultivars are available for horticultural uses but these are not suitable for reclamation purposes.
Uses: This plant is widely used as an ornamental shrub in gardens and public places (Elkington and Woodell 1963) as well as an erosion control along highways (Johnson et al. 1995).

Notes

Once established, the seedlings are durable and persistent. Shrubby cinquefoil is tolerant to poor soils, wet conditions, flooding and calcareous substrates (Anderson 2001).
Synonyms include: *Potentilla fruticosa* auct. non L. and *Dasiphora floribunda* (Pursh) Kartesz (ITIS n.d.).

Photo Credits

Photo 1: Walter Sigmund
http://commons.wikimedia.org/w/index.php?title=Dasiphora_fruticosa&oldid=13856945
Photo 2: Wild Rose Consulting, Inc.

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Scientific Name: *Hudsonia tomentosa* Nutt. **Family:** *Cistaceae*

Common Names: beach heather, woolly beach-heather, sand golden-heather

Plant Description

Low, under 20 cm tall, branched, perennial shrub forming mats or mounds from taproot; branches under scale like leaves, haired and grey-green, old branches red-brown to grey; Leaves evergreen, alternate, simple scale-like, overlapping, close to branches, glabrous; flowers perfect, conspicuous, golden yellow, 5 petals, 5 sepals, calyx hairy (Johnson et al. 1995).
Fruit: Smooth, egg shaped, loculed capsule enclosed by persistent calyx (Johnson et al. 1994).
Seed: Minute.

***Hudsonia tomentosa* in flower**

Habitat and Distribution

Habitat: Sand hills and sand dunes, often under *Pinus banksiana*.
Seral Stage: Pioneer species.
Soil: Coarse textured (Lady Bird Johnson Wildflower Center 2007).
Distribution: In northern Alberta. Southwestern District of Mackenzie, Alberta to southern Labrador, New Brunswick south to North Dakota, Minnesota, Great Lakes, West Virginia, North Carolina (Johnson et al. 1994, Moss 1983).

Phenology

Late spring bloom, fruit and seeding through summer to fall (USDA NRCS n.d.).

Pollination

Many members of *Cistaceae* are insect pollinated (Bosch 1992).

Genetics

2n=32 (Moss 1983).

Symbiosis

Buried phyllosphere (leaves) and rhizosphere (roots) associated with Green Sand or blue-green algae (Nelson et al. 1986).
H. tomentosa forms ectomycorrhizal associations with *Cenococcum geophilum* (Smreciu et al. 1997) and a white rhizomorphic mycorrhiza (Massicotte et al. 2010).

Seed Processing

Collection: Shattered material is easily collected from surroundings, seed removal from plant is challenging (Skaradek 2001).
Seed Weight: 2.4 g/1,000 seeds (Skaradek 2001).
Harvest Dates: August to September (Skaradek 2001).
Cleaning: Light use of hammermill or screen and separate mechanically (Skaradek 2001).
Storage Behaviour: Likely orthodox.
Storage: Store cold after drying to low relative humidity.
Longevity: No literature found.

Propagation

Natural Regeneration: From seed and rhizomes.

Germination: Smreciu et al. (1997) reported little germination 2 months following seeding.
Pre-treatment: Requires cold stratification (Skaradek 2001, USDA NRCS n.d.).
Direct Seeding: In greenhouse peat-sand mix, 215 g per square metre.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: Root, cuttings and container (USDA NRCS n.d.).
Micro-propagation: No literature found.

Hudsonia tomentosa habit and habitat

Aboriginal/Food Uses

Food: No literature found.
Medicinal: No literature found.
Other: No literature found.

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: Low palatability (USDA NRCS n.d.).
Grazing Response: No literature found.

Reclamation Potential

Capable of N-fixing and reducing acetylene via mycorrhizal associations; it is capable of colonizing sand blowouts (Nelson et al. 1986).

Commercial Resources

Availability: General retail, online and garden centers but no large scale commercial retailer (Skaradek and Miller 2009).
Cultivars: None known (Skaradek and Miller 2009).
Uses: No literature found.

Notes

May produce allelopathic compounds to reduce competition (Skaradek and Miller 2009).

Photo Credits

Photo 1: Christopher Miller USDA NRCS via Wikimedia Commons 2012.
Photo 2: Fungus Guy, Wikimedia Commons 2004.

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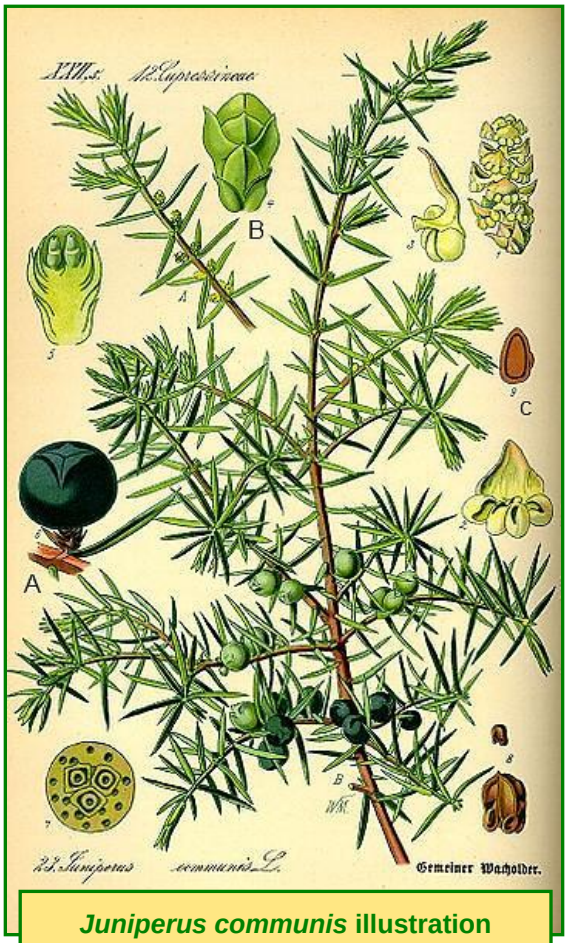
Scientific Name: *Juniperus communis* L. **Family:** Cupressaceae

Common Names: common juniper, ground juniper, dwarf juniper, low juniper



***Juniperus communis* illustration**
A. female cone B. Male cone C. Seed

Plant Description

Prostrate or spreading dioecious shrubs, usually forming carpets or broad clumps, sometimes 1 m high; evergreen needle-like leaves, whorls of three; 5 to 15 mm long, upper surface grooved and whitish green (Royer and Dickinson 2007).

Fruit: Male cones are small, appearing at the ends of branches; female cones are pale blue, berry-like, 6 to 13 mm across (Royer and Dickinson 2007).

Seed: Dormant embryo in a semi-permeable but thick seed coat (Rook 2002).

Habitat and Distribution

Open wooded areas and slopes, intolerant of heavy shade (Royer and Dickinson 2007, Thomas et al. 2007).

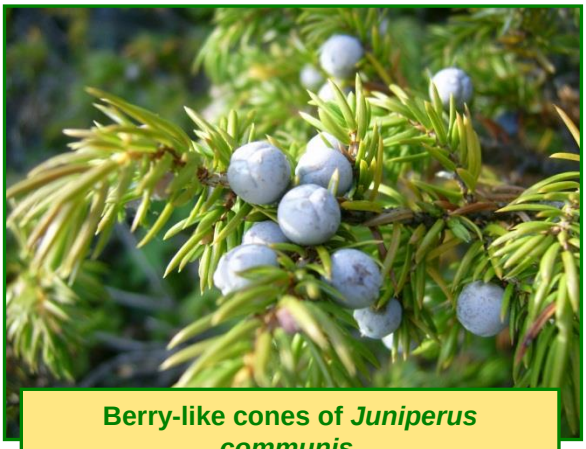
Seral Stage: Found in early to late successional communities (Tirmenstein 1999).

Soil: Can grow in coarse to fine textured soils as long as they are well drained (USDA NRCS n.d.). Drought tolerance is high and can grow in a pH range of 5.5 to 8 with a medium tolerance to salinity (USDA NRCS n.d.).

Distribution: Circumpolar: Alaska to Labrador and Newfoundland south to California, Colorado, southern Saskatchewan, southern Manitoba, Great Lakes, Appalachia (Moss 1983).

Phenology

Plants flower January to April. Fruit ripens from September to October (Young and Young 1992). Seed takes up to 3 years to ripen on the plant (Government of the Northwest Territories n.d., Verheyen et al. 2005).



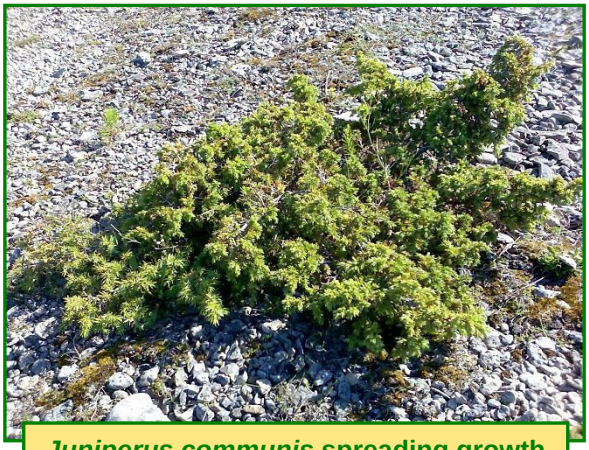
Berry-like cones of *Juniperus communis*.

Pollination

Wind pollinated (Hedge Nursery 2008).

Seed Dispersal

Birds are the main agent in seed dispersal for (Verheyen, et al. 2005).



***Juniperus communis* spreading growth form.**

Genetics

2n=22 (Moss 1983).

Symbiosis

Ectomycorrhizae do colonate but they appear to have a facultative relationship (Thomas et al. 2007). Endomycorrhizas are more common; the following arbuscular fungi associations have also been found with *J. communis* in Poland (Thomas et al. 2007).

Seed Processing

Collection: Juniper berries are collected in the fall by stripping or picking them off the shrub; collect as soon as they are ripe to avoid losses due to birds and rodents (Young and Young 1992).

Seed Weight: 23.3 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Seed by Weight: 80 seeds/g (Young and Young 1992).

Average Seeds/Fruit: 1 to 3 seeded (Royer and Dickinson 2007).

Harvest Dates: Seeds are harvested in autumn (Plants for a Future n.d.).

Cleaning: Seeds can be recovered by maceration and floatation (Young and Young 1992).

Storage: Store very well; they should be dried to 10% to 12% moisture and sealed in containers (Young and Young 1992).

Longevity: Seed is not persistent in the seed bank (Verheyen et al. 2005).

Propagation

Natural Regeneration: Reproduces by seed and layering though it is unclear if the layered piece continues to live after the original plant dies (Thomas et al. 2007, Tirmenstein 1999).

Germination: An experiment done by Djavanshir and Fechner (1976) showed that *Juniper spp.* germinate slowly due to a combination of dormancy and seed coat impermeability.

Viability of seed can range from 0% to 80% (Thomas et al. 2007).

With a pre-chill 90 days at 3 to 5°C germination should take about 28 days at temperature of 20°C (Young and Young 1992).

Pre-treatment: Using *J. virginiana* seeds, the highest rate of germination was achieved by soaking seeds for 96 hrs in 10,000 ppm of citric acid followed by 6 weeks warm stratification and 10 weeks of cold stratification (Van Haverbeke and Comer 1985).

Direct Seeding: Seeds must be planted in the fall; seedlings will appear in the second year (Young and Young 1992).

Juniper seeds are usually drilled in a well-prepared seedbed in rows 15 to 20 cm apart, covered with 0.6 cm of soil and mulched to protect plants from severe climate (Young and Young 1992).

Planting Density: 1,700 to 5,400 plants per hectare (USDA NCRS n.d.).

Seed Rate: No literature found.

Vegetative Propagation: Cuttings are easy to root but slow growing (Young and Young 1992).

Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: The berries would be dried whole and ground into meal for mush and for cakes; also used as a coffee substitute. Teas were made from the leaves, stems and berries of the plant. The bark could be consumed in times of famine to suppress hunger (Mackinnon et al. 2009).

Berries should not be eaten in large quantities as they may cause digestive upset and kidney irritation (Droppo 1987, Gray 2011, Wilkinson 1990).

Medicinal: Juniper berry tea is used to help digestion, stimulate appetite, relieve colic and water retention (it is a diuretic – Gray 2011), treat diarrhea, and heart, lung and kidney problems, prevent pregnancy, reduces swelling and calms hyperactivity. Teas were drunk to treat coughs, treat fevers, and to soak stiff and sore joints (Mackinnon et al. 2009, Wilkinson 1990).

The Cree use the inner bark as a poultice (Wilkinson 1990).

Also is found to have anti-mycobacterial properties (Carpenter et al. 2012). Leaves contain the antibiotic podophyllotoxin which has been found to be active against tumors (CYSIP: Botany n.d.).

Other: Beads for necklaces, the wood was used for lance shafts and bows, brown dye was also made from the berries, bark and needles (CYSIP: Botany n.d., Mackinnon et al. 2009, Wilkinson 1990). Used as fumigants, deodorizers and cleansers by BC Aboriginals (Wilkinson 1990). A decoction of the needles and branches can be used as a wash for dry, dandruff-prone scalp and as a facial astringent to help cure acne (Gray 2011).

Wildlife/Forage Usage

Wildlife: Deer, moose, mountain goats, hares, caribou all eat juniper only when other food sources are not available. Birds and small mammals eat the cones (Tirmenstein 1999).

It is also used as shelter and nesting areas for birds, rodents and deer (Tirmenstein 1999).

Livestock: Will only consume if there is no other food source present (Tirmenstein 1999). Believed to be toxic to livestock (Wilkinson 1990).

Grazing Response: Juniper is a decreaser (Tirmenstein 1999).

Reclamation Potential

Useful for preventing erosion (Tirmenstein 1999).

May act as a nurse species; it protects other growing shrub species from predation by large herbivores and will provide a cool growing environment for mosses and lichens (Thomas et al. 2007).

Are acid tolerant and drought tolerant and were moderately successful when they were used in a reclamation trials on sandy mine sites in Denmark (Cornwell and Kiff 1973).

Commercial Resources

Availability: Is available from nurseries in Alberta. (ANPC 2010).

Cultivars: Gold cone and Golden Schnapps (Rook 2002).

Uses: They are well known for their use in flavoring gin, beer and other alcoholic beverages. They were also picked, mashed and dried into cakes for winter food (Mackinnon et al. 2009).

A scented wax which can be used for candles can be obtained by boiling the waxy coating off the berries (CYSIP: Botany n.d.).

Photo Credits

Photo 1: Fungus Guy 2010.

Photo 2: Paul Hänninen 2007.

Line Diagram: Prof. Dr. Otto Wilhelm Thomé Flora von Deutschland, Österreich und der Schweiz 1885, Gera, Germany.

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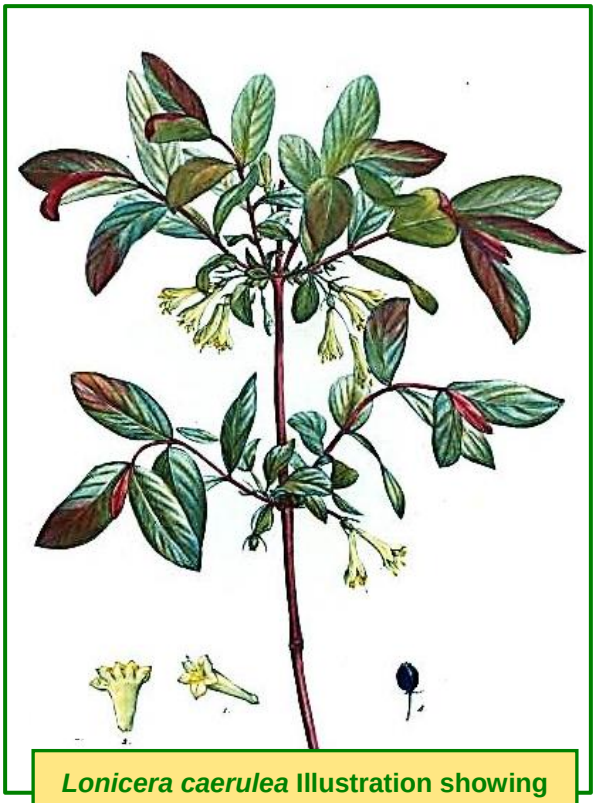
Scientific Name: *Lonicera caerulea* L. **Family:** *Caprifoliaceae*

Common Names: blue fly honeysuckle, mountain fly honeysuckle, sweetberry honeysuckle, honeyberry



***Lonicera caerulea* Illustration showing the flowers (left) and the fruit (right) of the plant.**

Plant Description

Low, erect shrub up to 1 m tall; hairy young stems; reddish brown to grey bark on older twigs; simple, opposite leaves mostly oblong and blunt at apex, 2 to 6 cm long, pubescent beneath; pairs of yellow flowers on short stalks from leaf axils enclosed at base by linear-subulate bracts longer than the ovaries, corolla 10 to 15 mm long (Moss 1994).

Fruit: Blue berry, up to 1 cm long covered with blue bloom, variable shape (round, oval, ovate, long and thin) (Moss 1994).

Seed: Flat, ovoid, brown 1.5 to 2.0 mm long (Moss 1994).

Habitat and Distribution

Found in swamps, bogs, treed fens and stream banks across the boreal forest of prairie provinces.

A non-dominant species often in association with high organic matter containing soils and where deciduous trees are doing poorly. Also along wetland edges and climax forests. Few plants usually seen at each location (Bors pers. comm.).

Soils: Adapted to acid soils (pH 5 to 7) and require mesic soils for optimum growth (Thompson 2006).

***Lonicera caerulea* flowers in bloom.**

Grows in soils with high organic matter (Bors pers. comm.).
Distribution: Circumpolar: British Columbia to California; Alberta to Newfoundland south to Minnesota, Wisconsin, Michigan, Pennsylvania (Moss 1983).

***Lonicera caerulea* seed; 1.5 to 2.0 mm long.**

Phenology
Flowers in May to June (Johnson et al. 1995).

Pollination
Cross-pollination and limited self-pollination. Honeybees, mason bees (*Osmia lignaria*) and bumblebees are recognized pollinators (Thompson 2006).

Seed Dispersal
Spread mainly by frugivorous birds (Munger 2005).

Genetics
2n=18, 36.

Seed Processing
Collection: Collect fruit by hand.
Seed Weight: 0.3929 to 0.6531 g/1,000 seeds (0.5263 g/1,000 seeds average).
Fruit/Seed Volume: 1,850 to 3,370 fruit/L, 2,450 fruit/L average (24,500 seeds/L fruit).
Fruit/Seed Weight: 3,410 to 5,880 fruit/kg, 3,940 fruit/kg average (43,500 seeds/kg fruit).
Average Seeds/Fruit: 10 seeds/fruit.
Harvest Dates: Late July.
Cleaning: Place fruit for a few hours in small polyethylene bag in aqueous solution containing several drops of pectinase enzyme. Massage softened fruit in bag until well disintegrated, and then decant solution containing mashed fruit (a second or third rinsing and decanting may be necessary). The seeds, being heavier, drop to the bottom of the container free of fruit tissues (Thompson 2006).
Longevity: Germination percentages drop after one year of storage (Smreciu and Gould 2009).

Propagation
Natural Regeneration: By seeds.
Germination: Smreciu et al. (2006) obtained 61% germination after 30 days with fresh seeds and 21% after 30 days with one year old seeds.
Pre-treatment: Four weeks cold stratification.
Micro-propagation: Can be propagated by tissue culture. Adding diluted mineral supplies to the micro-cuttings increases the root systems by allowing more root elongation. Continuous auxin treatments accelerate the induction of rooting and produce more primary roots (and possibly larger ones) and more lateral root branches (Karhu 1997).
Micro-propagation leads to high health status and multiplication rates (Dziedzic 2008). Higher root and shoot mass was attained in a study by Dziedzic (2008) when acclimatization took place in peat medium with Agro-AquaGel® supplements.
Softwood cuttings provide satisfactory results (Dziedzic 2008).

Aboriginal/Food Uses
Food: Fruit are eaten fresh, are very high in vitamin C content and possess antioxidant properties.
Medicinal: Used in cardiovascular disease therapy, reduces blood pressure, and can have curative effects for malaria and gastrointestinal diseases (Thompson 2006).

Wildlife/Forage Usage

Wildlife: Early ripening berries may be food source for birds and mammals (Bors pers. comm.).

***Lonicera caerulea* shrub showing upright nature.**

Commercial Resources

Availability: Not available commercially must be wild harvested.

Cultivars: Numerous horticultural cultivars are known but none are suitable for reclamation purposes.

Uses: Ornamental shrub, a potential new berry crop. Fruit are used in Japan for making juice, assorted candies, jam, jelly, gelatin, ice cream, yogurt, fruit cake, tarts, soda pop, wine, canned fruit, tea, berry bars, chewing gum (Thompson 2006).

Notes

Lonicera caerulea is listed as 99% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

In Siberia, northern China, Hokkaido, and the northern island of Japan, where the edible-fruited subspecies are native, large quantities of berries are wild collected by local people. However, here in North America blue honeysuckle have inferior quality fruit. For this reason, the berry has not been a point of interest for fruit researchers or consumers here (Thompson 2006). Work is currently being done at the University of Saskatchewan on developing a gene bank of blue honeysuckle and breeding Canadian plants with those collected from Japan and Russia.

Photo Credits

Photos: Wild Rose Consulting, Inc.

Line Diagram: Pierre-Joseph_Redouté @Wikimedia commons.

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Scientific Name: *Lonicera dioica* L. var. glaucescens (Rydb.) Butter
Family: *Caprifoliaceae*

Common Names: twining honeysuckle, limber honeysuckle

***Lonicera dioica* illustration a. branch with leaves and flowers b. flower c. fruit d-e. seeds f. pollen**

Plant Description

Woody vein stems 1 to 3 m tall, twining, bark shredding; leaves opposite, deciduous, oval to oblong, 5 to 8 cm long, upper surface smooth, underside hairy; lower leaves short-stalked, upper leaves stalkless; upper pair may be fused to form a cup around the stem; flower cluster spike 3 to 9 flowers, yellow to reddish orange, tubular 1.5 to 2.5 cm long, five sepals, five petals (Moss 1983, Royer and Dickinson 2007).

Fruit: Red berry 5 to 8 mm across (Royer and Dickinson 2007).

Habitat and Distribution

Open woods, rocky slopes, fence lines (Moss 1983, Royer and Dickinson 2007). Prefers shade (Inkpen and Van Eyk n.d.).
Soil: Can tolerate xeric to subhydric moisture regime (E-Flora BC 2013).
Distribution: Southwestern District of Mackenzie, southeastern British Columbia to Quebec south to Alberta, Nebraska, Oklahoma, North Carolina (Moss 1983).

Phenology

Flowers from May to July, seeds ripen July to September, seeds can disperse from June to October (Young and Young 1992).

Pollination

Insect and humming bird pollinated like many other *Lonicera* species (Gould pers. comm., Lady Bird Johnson Wildflower Center 2012).

Seed Dispersal

Fructivores; fruit is eaten by birds (Tannas 1997).

Genetics

2n=18 (Moss 1983).

Seed Processing

Collection: Fruit should be handpicked or stripped from branches soon after ripening to prevent losses from wildlife consumption (Young and Young 1992).
Seed Weight: 20 seeds/g or 50 g/1,000 seeds (Young and Young 1992).
Harvest Dates: July to October (Young and Young 1992).

Cleaning: Maceration and floatation to recover seeds; dry completely before storing (Young and Young 1992).
Storage Behaviour: Not proven but thought to be Orthodox; seeds can be dried, without damage, to low moisture contents; their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Dried seed can be stored in sealed containers at cool temperature (Young and Young 1992).
Longevity: Reported to have little loss in viability when stored in sealed containers at cool temperatures for 15 years (Young and Young 1992).

***Lonicera dioica* blooming**

Propagation

Natural Regeneration: By seed (Young and Young 1992).
Germination: Epigeal germination (Young and Young 1992).
Royal Botanic Gardens Kew (2008) achieved 80% germination seeds when germinated on a 1% agar media at temperatures of 20/10°C (8 hours day / 16 night) with pre-treatments.
Bonner and Karrfalt (2008) report 90% germination after 80 to 100 days at 30°C day / 20°C night on sand.
Pre-treatment: Cold stratification (Young and Young 1992); cold-moist stratification (Lady Bird Johnson Wildflower Center 2012). Royal Botanic Gardens Kew (2008) treated the seed with a cold stratification for 8 weeks at 5°C followed by a warm stratification at 20°C for 4 weeks, then scarified using a scalpel.
Direct Seeding: *Lonicera sp*. are sown either by broadcast seeding or in drill rows in the fall or in the spring with pre-treated seeds (Young and Young 1992). Seeds should be sown 0.6 cm deep in a mulched bed (Young and Young 1992).
Vegetative Propagation: Most *Lonicera* species can be propagated by cuttings (Bonner and Karrfalt 2008, Young and Young 1992).

Aboriginal/Food Uses

Medicinal: Stems used as a diuretic, to treat heart ailments; roots used to treat bladder problems and constipation (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Berries are eaten by birds (Droppo 1987); poor forage only used when no other food sources are present (Tannas 1997).

***Lonicera dioica* with berries**

Livestock: Not generally consumed by livestock (Tannas 1997).
Grazing Response: Increasers but not invasive (Tannas 1997).

Reclamation Potential

Valuable for erosion control and species diversity (Young and Young 1992).

Commercial Resources

Availability: Not available in Alberta.

Notes

Synonym is *L. glaucescens (*E-Flora BC 2013, USDA NRCS n.d.).
Lonicera dioica is listed as 84% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Kay Yatskievych 2003. @ www.discoverlife.org.
Photo 2: William S. Justice @ USDA-NRCS PLANTS Database.

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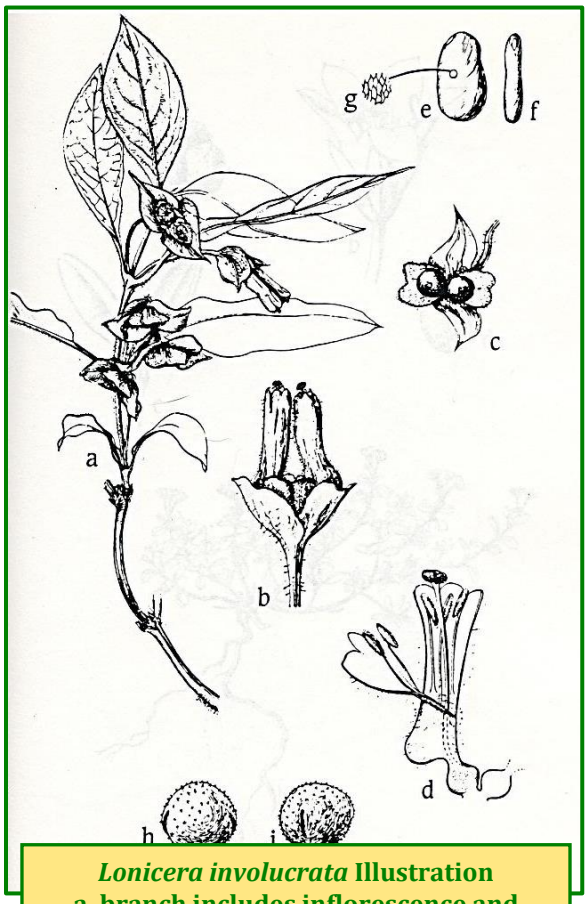
Scientific Name: *Lonicera involucrata* (Richards.) Banks
Family: *Caprfoliaceae*
Common Names: bracted honeysuckle, black twinberry, swamp honeysuckle



***Lonicera involucrata* Illustration**
a. branch includes inflorescence and leaves b. flowers c. fruit d. flower dissected e-f. seeds h-i. pollen

Plant Description

Erect or ascending shrub 1 to 3 m high; leaves opposite, short petioled, ovate to obovate, 5 to 15 cm long, acute or acuminate at apex, more or less pubescent; flowers in pairs, bracts green to deep purple, ascending, finally reflexed, 1 to 2 cm, corolla yellow 10 to 13 mm long (Moss 1983).
Fruit: Berries are purple-black about 8 to 10 mm in diameter, unpleasant flavour (Droppo 1987, Moss 1983, Wilkinson 1990).
Seed: Flat oval seed 1 to 2 mm long.

Habitat and Distribution

Moist woods (Moss 1983). Moderately shade intolerant prefers the sun (E-Flora BC 2013).
Soil: Occurs only on very moist to wet nitrogen-rich soils (E-Flora BC 2013).
Soil pH 5.5 to 8 and no salinity tolerance (USDA 2013).
Distribution: British Columbia to Quebec south to California, New Mexico, Wisconsin, Michigan (Moss 1983).

Phenology

Lonicera involucrata flowers from June to July and berries appear July to August (Bonner and Karrfalt 2008). Fruit is indeterminate; fruit does not all ripen at the same time (Terpstra pers. comm.).

Lonicera involucrata in flower

Pollination
Insect pollinated (Plants for a Future n.d.).

Seed Dispersal
Mostly by birds but can be carried by other browsers (McLaughlin 2013).

***Lonicera involucrata* branch with berries**

Genetics
2n=18 (Moss 1983).

Seed Processing
Collection: *Lonicera* spp. should be hand picked or stripped from the branches as soon after ripening as possible to reduce loses to birds. Most *Lonicera* spp. hybridise easily so it is better to collect seed from isolated populations (Young and Young 1992).
Seed Weight: 720 seeds/g or 1.39 g/1,000 seeds (Young and Young 1992).
1.33 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: July to August (Bonner and Karrfalt 2008).
Cleaning: Maceration and flotation can be used to extract the seeds from the fruit (Young and Young 1992).
Storage Behaviour: Not proven but thought to be orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature, in a quantifiable and predictable way (Royal Botanic Gardens Kew 2008).
Storage: Dried seed can be stored in sealed containers at low temperatures (Young and Young 1992).
Longevity: Heit (1967) stored seed up to 15 years with little loss in viability. Can be stored for several years in dry storage at room temperatures (Royal Botanic Gardens Kew 2008).

Propagation
Germination: Germination takes 40 to 60 days and 15% of seeds sown will produce seedlings (Young and Young 1992).
Royal Botanic Gardens Kew (2008) achieved 90% germination on a 1% agar media at 15°C , 8 hours day and 16 hours night.
Pre-treatment: Seeds of most species of *Lonicera* show some dormancy, due to seed coat or a dormant embryo (Young and Young 1992); stratification is necessary (Lady Bird Johnson Wildflower Center 2011). Royal Botanic Gardens Kew (2008) sterilized their seed in 10% domestos solution for 5 minutes, then stratified the seed for eights at 5°C.
Cold stratification is required for all species (Young and Young 1992). Seeds must be cold stratified for 30 to 90 days (Bonner and Karrfalt 2008).
Direct Seeding: Seed can be either broadcast or a seed drill can be used in the fall with pre-treated seeds sown in the spring (Young and Young 1992). Seeds should be covered with 3 to 6 mm of soil and covered with 5 to 7.5 cm of straw mulch to prevent excessive drying (Bonner and Karrfalt 2008).
Vegetative Propagation: Most *Lonicera* spp. can be propagated from cuttings (Lady Bird Johnson Wildflower Center 2011, Young and Young 1992). Do very well planted as live stakes (Polster 2011).

Aboriginal/Food Uses
Food: They are possibly poisonous (Lady Bird Johnson Wildflower Center 2011, Mackinnon et al. 2009, Turner 1997, Wilkinson 1990), however Plants for a Future (n.d.) indicate fruit is edible.
Medicinal: *Lonicera involucrata* bark was taken for coughs and its leaves were chewed and applied

externally to itchy skin, boils and gonorrhoeal sores (Mackinnon et al. 2009). Berry tea was used to purify the body and cleanse the chest, decoctions where used to cleanse sore eyes. Boiled leaves and twigs where applied to swellings sores, scabs and broken bones (Mackinnon et al. 2009). Boiled bark was applied to burns, infection and wounds (Mackinnon et al. 2009).

Other: The stems were used to make fibres for mats, baskets, bags, blankets and toys (Mackinnon et al. 2009). The hollow stems were used by children as straws (Mackinnon et al. 2009).

Black or purple dye was made from crushed berries (Mackinnon et al. 2009, Wilkinson 1990). The plant was also used as an ornamental (Mackinnon et al. 2009).

Berries were rubbed into the scalp to prevent hair from turning grey (Wilkinson 1990).

***Lonicera involucrata* seed.**

Wildlife/Forage Usage

Wildlife: Birds eat the berries and hummingbirds and butterflies consume nectar from flowers (Always 2007, Lady Bird Johnson Wildflower Center 2011). Generally unpalatable for wildlife browsing (Sampson and Jespersen 1963) though said to be a favourite of bears (Turner 1997, Wilkinson 1990).

Livestock: Generally unpalatable to livestock (Sampson and Jespersen 1963).

Reclamation Potential

As a pioneering species, dormant branches are useful as live stakes, wattle fences and other soil bioengineering practices for stabilizing mesic to moist areas (Polster 2011).

Commercial Resources

Availability: Plants available at one nursery in Alberta (Alberta Native Plant Council 2010). Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.

Notes

L. involucrata is listed as 79% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Walter Siegmund. 2009. @ Wikipedia Commons.

Photo 2: Steve Hurst @ USDA-NRCS PLANTS Database.

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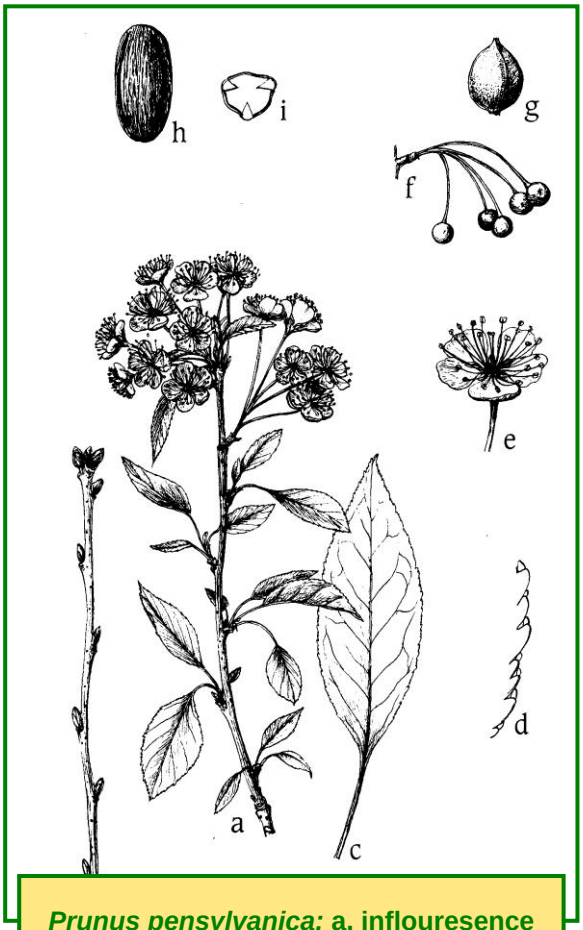
Young, J.A. and C.G. Young, 1992. Seeds of woody plants in North America. Dioscorides Press, Portland, Oregon. 407 pp.

Scientific Name: *Prunus pensylvanica* L. **Family:** *Rosaceae*

Common Names: pin cherry, fire cherry, wild red cherry, pigeon cherry, bird cherry



Prunus pensylvanica: **a. inflouresence b. winter twig, c. leaf d. leaf margin e. flower f. fruit g. seed h&i. pollen**

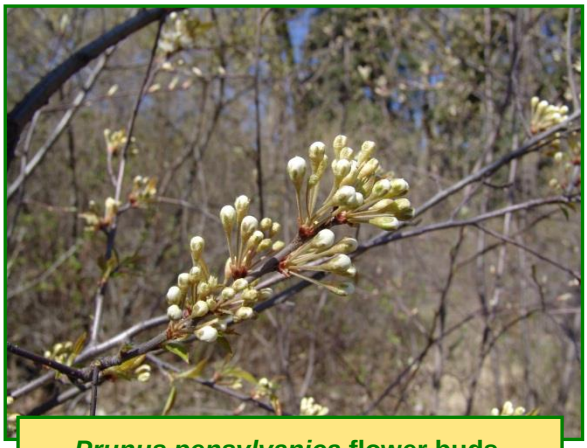
Plant Description

Perennial, slender shrub or small tree, 8 m, reddish brown branches with orange lenticles; alternate, simple, lance to oblong leaves, coming to a point, 5 to 10 cm, toothed margins; 2 to 5 cm clusters of flowers occurring from leaf axis with white petals, 6 mm, fuzzy on back (Moss 1983). Plants live to 40 years (Government of the Northwest Territories n.d.).

Fruit: Drupe, spherical, 5 to 8 mm, red, glossy, sour (Moss 1983).
Seed: One seed per drupe, 5 to 7 mm stone, ridged margin, oval, whitish to leather yellow, rough (Moss 1983).

Habitat and Distribution

Pin cherry occurs in open woods, clearings and ravines (Moss 1983). It is often associated with forests of *Populus tremuloides, Betula papyrifera, Prunus virginiana,* and *Pinus banksiana*. Other shrubs found with pin cherry include *Amelanchier alnifolia, Symphoricarpos albus, Ribes* sp., *Vaccinium* sp., *Arctostaphylos uva-ursi,* and *Rubus* sp. (Anderson 2004).
Seral Stage: Relatively shade intolerant therefore seldom found in mature forests (Inkpen and Van Eyk n.d.); pin cherry may pioneer disturbed area, such as landslides, as well as logged and burned areas (Anderson 2004).
Soils: Infertile, rocky, and sandy well-drained soils; moist loamy soils and rich loams (Burns and Honkala 1990).
Tolerant of acidic conditions (Anderson 2004).
Distribution: Southwestern District of Mackenzie, eastern British Columbia to Newfoundland south to

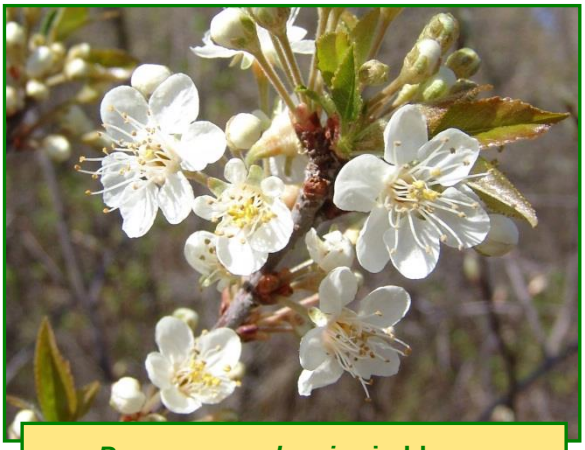


Prunus pensylvanica **flower buds.**

Montana, Colorado, South Dakota, Louisiana, Indiana, Virginia (Moss 1983).

Phenology

Flower buds appear in August or September and open between April and July of the following year. Fruit ripens in July through September. Seeds mature in time with fruit.



***Prunus pensylvanica* in bloom.**

Pollination

Cross-pollinated by bees, butterflies and other insects (Anderson 2004).

Seed Dispersal

Two phased dispersal, first by birds, and other fructivores (Anderson 2004) and then deposited in soil by seed hoarding rodents (Beck 2009).

Genetics

2n=16, 32 (Moss 1983).

Seed Processing

Collection: Seeds can be hand harvested or shaken from trees onto tarps.

Harvest Dates: Collect mid to late July or early August, when fruit are bright red in colour (Banerjee et al. 2001).

Collect August 1 to August 30 (Formaniuk 2013).

Cleaning: Mash fruit by hand or using a potato masher, apple-saucer, or ricer, or run through a hand meat grinder. Alternatively, use a food processor on low speed with blunt mashing blade (not a sharp blade) or use a blender with blades covered by plastic tubing or duct tape. Suspend residue in water and mix. Allow seeds to settle and decant water with floating and suspended larger chaff. Repeat this step until seeds are clean. Sieve and place seeds on paper towel or cloth to dry. Dry at room temperature or up to 25°C preferably over a moving air stream.

Seed Weight: 34.4827 g/1,000 seeds.

45.8 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Fruit Volume: 1,620 fruit/L (1,620 seeds/L fruit).

Fruit Weight: 3,310 fruit/kg (3,310 seeds/kg fruit).

Average Seeds/Fruit: One seed/fruit.

Storage Behaviour: Orthodox; seeds can be dried, without damage, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).

Storage: Stored dry in containers at cool temperatures. 76% germination after 10 years hermetic air-dry storage at 1° to 3°C (Royal Botanic Gardens Kew 2008).

Longevity: *P. pensylvanica* seeds have been kept for up to 10 years when stored in sealed containers at 1° to 4°C (Vilkitis 1974).

Propagation

Natural Regeneration: Primarily by rhizomes and to a lesser extent by seeds (Gerling et al. 1996).

Germination: No significant germination (<10%) regardless of treatment.

>75% germination after 24 hours scarification in a chemical solution (0.5 M hydroxylammonium chloride) followed by a series of drastic temperature fluctuation treatments – a very time consuming and tedious process (Laidlaw 1987). 62% germination in 60 days after 60 day stratification at alternating temperatures of 20° to 30°C and 90 day stratification between 3° to 5°C (Grisez 1974).

Pre-treatment: 60 day cold stratification before seeding (Wood pers. comm.); Cold stratification 120 to 150 days at 3° C is recommended by Nichols (1934); 120 days stratification (Formaniuk 2013).

Direct Seeding: Produced vigorous seedlings (>4% emergence the second growing season and >3% the fifth growing season).
Seed Rate: 50 fruit/m².
Vegetative Propagation: Suckers readily and root cuttings may be a successful transplanting mechanism. Can be propagated through rhizome cuttings (Johnson 2000).
Micro-propagation: Pruski et al. (2000) describe tissue culture methods used to propagate cultivars of *Prunus pensylvanica*.
Greenhouse Timeline: 20 weeks in the greenhouse before out-planting. Plants can be over wintered for spring or September out planting (Wood pers. comm.). Grow for 180 days before harvest (Formaniuk 2013).

Seeds of *Prunus pensylvanica*, approximately 5 mm.

Aboriginal/Food Uses

Food: Fruit is made into jelly, pemmican and wine (Marles et al. 2000). Pits contain cyanic acid and are potentially fatal if eaten in large quantities; all other parts of the plant except the fruit contain hydrocyanic acid and may be poisonous if consumed (Royer and Dickinson 1996, Wilkinson 1990).
Medicinal: Fevers are treated with parts of the bark, fruit, leaves and roots. Eyewash can be prepared from the bark and whooping cough is treated with concoctions from the root (Marles et al. 2000).
Other: Fruit is used to create a dye (Marles et al. 2000). Narrow strips of bark were used as rope (Royer and Dickinson 1996).

Wildlife/Forage Usage

Wildlife: Birds and mammals feed on fruit of pin cherry trees aiding in seed dispersal. Deer also browses the foliage. Sharp-tailed and ruffed grouse eat the buds and the fruit (Anderson 2004).
Livestock: Occasionally poisonous to sheep and cattle; leaves lethal to livestock – Droppo (1987). Less palatable to livestock.
Grazing Response: Decreaser (Gerling et al. 1996).

Reclamation Potential

Salvaging topsoil may preserve pin cherry seeds in seed bank. Cutting stems may result in as many as 32 suckers (Jobidon 1997). Pin cherry is an early successional species that undergoes rapid growth and plays an important role in minimizing nutrient loss and erosion (Burns and Honkala 1990). Pin cherry rapidly develops young, very dense stands following disturbance. It reduces erosion and nutrient losses by slowing runoff, and it incorporates nutrient elements into the developing biomass (Marks and Bormann 1972).

Commercial Resources

Availability: Available from various commercial sources in Alberta.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: Cultivars and species available by mail order from specialty suppliers are not suitable for reclamation purposes in Alberta.
Uses: This plant is used as a grafting and budding stock for sour cherry in the nursery trade (Burns and Honkala 1990). Fruit are used to make jellies, wines and syrups.

Notes

Prunus pensylvanica is listed as 83% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photos 1 & 2: Allan Carson, University of Northern British Columbia, British Columbia.
Photo 3: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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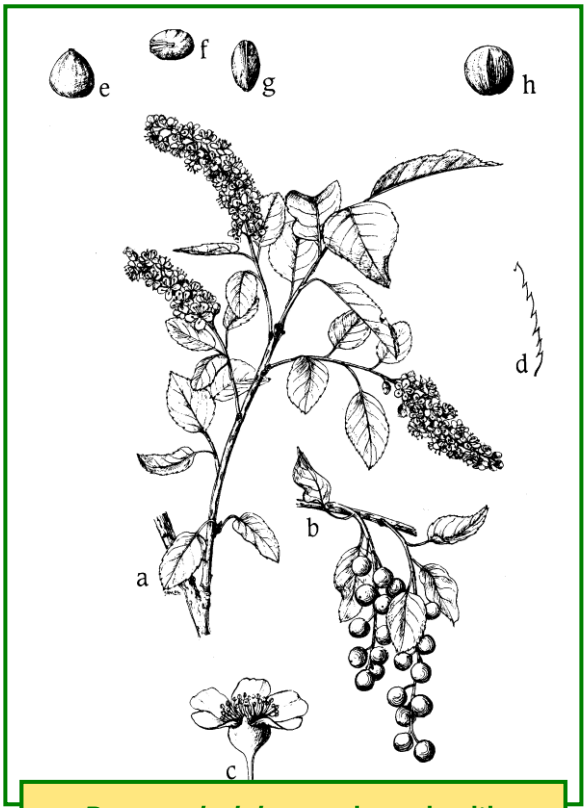
Scientific Name: *Prunus virginiana* L. **Family:** *Rosaceae*

Common Names: chokecherry, common chokecherry, Virginia chokecherry



***Prunus virginiana*. a. branch with inflorescences. b. fruit clumps. c. individual flower. d. leaf serrations. e-g. seeds. h. pollen.**

Plant Description

Perennial slender shrub or tree, 10 m high; reddish brown bark with inconspicuous lenticles; leaves alternate, simple, elliptical to egg-shaped, 5 to 10 cm, lighter beneath, smooth, toothed margins; racemes, 5 to 15 cm, terminal with white flowers, 4 to 10 mm across, 5 petals; widely branching roots (Moss 1983).

Fruit: Glossy, red-purple drupe, astringent, spherical, 1 to 2 cm diameter (Moss 1983).

Seed: 5 x 7 mm, oval, rough texture, brown, one margin ridged, and other scored. Large seeds tend to occur on upland sites while more numerous smaller seeds can be found in riparian areas (Parciak 2002a, b).

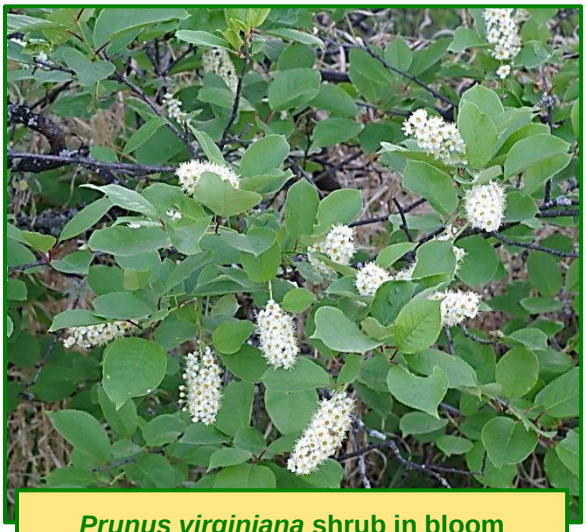
Habitat and Distribution

Found in a variety of forested areas as well as thickets, ravines, shores and sand dunes, and along fence lines and roadsides (Moss 1983).
Semi-tolerant to shade (Hardy BBT 1989).
Drought resistant (Inkpen and Van Eyk n.d., Kindscher 1987).

Seral Stage: Typical of a variety of stages ranging from post-disturbance (primary) to climax (Johnson 2000).

***Prunus virginiana* seedlings grown from berries grown on a revegetated site.**

Soils: Most productive on rich, moist loamy soils, but will grow on a wide variety of soils and moisture regimes (Hardy BBT 1989). Intolerant to poor drainage and prolonged flooding (Johnson 2000). Optimum soil pH 6.0 to 8.0 (Vilkitis 1974). It tolerates moderately acidic (pH 5.0), moderately basic, and weakly saline soils (Johnson 2000).
Distribution: Widespread across Alberta: Rocky Mountains, foothills prairie, and parkland. Southwestern District of Mackenzie, British Columbia to Newfoundland south to California, New Mexico, northern Texas, Oklahoma, Arkansas, Tennessee, North Carolina (Moss 1983).



***Prunus virginiana* shrub in bloom**

Phenology

Leaves open in May with flowers a few weeks later. Fruit matures in late July through September with seeds ripening at the same time.

Pollination

Pollinated by bees, butterflies and other insects (Young and Young 1992).

Seed Dispersal

Two phased dispersal, first by birds, and other fructivores and then deposited in soil by seed hoarding rodents (Beck 2009).

Genetics

2n=16, 32 (Moss 1983).

Symbiosis

None (Pashke et al. 2002).

Seed Processing

Collection: Easy to strip berries from branches in clusters.
Seed Weight: 52.6 to 75.0 g/1,000 seeds (64.7 average).
81.1 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Fruit/Seed Volume: 1,000 to 1,520 fruit/L (1,200 average), 1,200 seeds/L fruit.
Fruit/Seed Weight: 1,490 to 2,510 fruit/kg (2,090 average), 2,090 seeds/L fruit.
Average Seeds/fruit: 1 seed/fruit.
Harvest Dates: August 1 to August 30 (Formaniuk 2013). Collect when fully mature to facilitate cleaning and enhance germination success. Ripe fruit are red-purple in colour (Banerjee et al. 2001).
Cleaning: Mash fruits by hand or use a potato masher, apple-saucer, or ricer, or run through a hand meat grinder. Alternatively, use a food processor on low speed with blunt mashing blade (not a sharp blade) or use a blender with blades covered by plastic tubing or duct tape. Suspend residue in water and mix; allow seeds to settle and decant water with floating and suspended larger chaff. Repeat this step until seeds are clean; sieve and place seeds on paper toweling or cloths to dry. Dry at room temperature or up to 25°C preferably over a moving air stream.
Storage Behaviour: Orthodox; dry seed to low relative humidity prior to storage at freezing temperatures (Royal Botanic Gardens Kew 2008).
Storage: Store in hermetically sealed containers at freezing temperatures (Royal Botanic Gardens Kew 2008).
Longevity: Clean seeds, stored just below surface dry conditions and sealed in containers at 1°C can remain viable for up to 5 years (Rose et al. 1998).

***Prunus virginiana* seed**

Propagation

Natural Regeneration: From seed and by rhizomes or basal sprouts (Johnson 2000, Pashke et al. 2003).

Germination: No significant germination (<10%) in vitro regardless of treatment.

27ºC day / 21ºC temperature regime provide the best seed germination results (Lockley 1980).

25ºC day / 10ºC germination temperatures was used to germination seed from deciduous forests (Baskin and Baskin 2001).

Pre-treatment: 60 day cold stratification prior to sowing (Wood pers. comm.). 120 days stratification (Formaniuk 2013).

Hudson and Carlson (1998) suggest scarifying for 15 to 90 minutes, followed by 2 months warm stratification, and 4 months cold stratification.

There is evidence that ingestion by wild black bears significantly improves germination percentages because of the acid and mechanical scarification of seeds in the digestive tract (Auger et al. 2002).

Lockley (1980) had successful germination after 16 to 24 weeks cold stratification (3ºC) followed by a 21 to 27ºC temperature regime.

Dirr and Heuser (1987) obtained 52% germination after 6 months cold stratification. 120 to 160 days cold stratification provided the best germination results (Baskin and Baskin 2001).

Direct Seeding: Less than 1% emergence, however seedlings are vigorous on oil sands reclamation sites in north-eastern Alberta.

Fruit Sowing: In northeastern Alberta, 3% of fruit sown in fall emerged by year 4, resulting in vigorous seedlings.

Sowing Spacing: 0.2 to 0.3 m (Paschke et al. 2003).

Seeding Rate: 100 seeds/m², 50 fruits/m² to obtain 1 to 2 plants/m².

Vegetative Propagation: Rooted cuttings can be successful. Terminal and basal cuttings harvested in June have been rooted using 8,000 ppm IBA-talc, sand and mist (Dirr and Heuser 1987).

Babb (1959) reports successful propagation by suckers and budding.

Micro-propagation: Propagation is also possible with 15 cm long semi-hardwood cuttings, crown division, grafting and through micro-propagation (tissue culture) (St-Pierre 1993).

Nursery Production: Optimal conditions for nursery production are moist sand: peat, moist vermiculite, or 1:1 peat: perlite, and bright light favours growth and development (St-Pierre 1993).

Greenhouse Timeline: 20 weeks in the greenhouse prior to outplanting. Dormant seedlings can be stored frozen over winter for spring or early fall planting (Wood pers. comm.). Grow for 180 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Can be eaten fresh, frozen, or cooked, added to pemmican once dried, fermented to make wine, used for jellies, syrups, and sauces with meat and stews. The Blackfoot ground the entire fruit (even the pit which is somewhat toxic) and formed dry cakes which they ate as trail food (Royer and Dickinson 1996). A principal ingredient in pemmican (Kindscher 1987). Still collected in the wild in large quantities (Marles et al. 2000).

All parts of the plant except the fruit may contain hydrocyanic acid and may be poisonous if consumed (Royer and Dickinson 1996); children have died from eating large quantities without removing seeds (Turner 1997).

Medicinal: Boiling the leaves, stems, bark, and roots makes a tea useful for treating colds (Royer and Dickinson 1996, Turner 1997), fever (Wilkinson 1990), pneumonia, to clear the throat, and to treat high blood pressure and heart problems. Boiled bark can be used as an emetic drink or chewed and placed on wounds to stop bleeding (Wilkinson 1990). Boiled roots can make a tea to treat flu or be part of a medicine to treat diarrhoea in children (Marles et al. 2000).

Other: Wood used for digging sticks, roasting skewers, arrows and tipi construction (Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Browsed by elk, bear, coyotes, pronghorn, deer, moose, and bighorn sheep (Johnson 2000). Flowers are an important source of nectar for butterflies, honeybees, and ants (USDA NRCS n.d.). A variety of bird species (ruffed, blue, and sharp-tailed grouse, quail, prairie chicken, ring-necked pheasant, magpie), cottontail rabbits, chipmunk, black bear and mule deer feed on the berries.

Provides important cover and habitat for many bird species, small mammals, large mammals and livestock (Johnson 2000).

Livestock: Occasionally poisonous to sheep and cattle (prussic acid – Kindscher 1987; hydrocyanic acid in leaves – Droppo 1987), especially leaves injured by frost or extreme drought (Droppo 1987). Moderately palatable to livestock.

Grazing Response: Tolerates moderate grazing. Will resprout from root crown.

Reclamation Potential

Chokecherry has a high suitability for erosion control and soil stability because it can form thickets and spread by rhizomes (Inkpen and Van Eyk n.d.).

Chokecherry is well adapted to disturbed sites and is a fast-growing very competitive shrub (St-Pierre 1993) that has proven to be somewhat salt tolerance (Johnson 2000).

Smreciu and Barron (1997) found that plant salvage was extremely successful if plants were potted and maintained in a nursery for one growing season and placed when dormant.

Commercial Resources

Harvest Methods: Handpicking, using a berry rake, or a small power vibrator, mechanical harvesters (a pull type harvester or a self-propelled harvester) (St-Pierre 1993).

Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.

Availability: Available from a wide variety of sources. Both seed and seedlings available.

Cultivars: Numerous cultivars are available for fruit production in Manitoba and Alberta (St-Pierre 1993) and as ornamentals (Wilkinson 1990) but these are not suitable for use in reclamation.

Uses: Established market for jellies, wines, syrup, cough syrups, and ornamental shrub. Also used as windbreakers in the prairies, plains, and western mountains (Johnson 2000).

Notes

P. virginiana is listed as 91% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Chokecherry is well adapted to fire disturbance. Because of vigorous sprouting from surviving root crowns and rhizomes, chokecherries have a moderately rapid recovery and density increases following a fire.

Due to the production of hydrocyanic acid formed only after disruption of the plant cell (mechanical injury or a sudden change in temperature), the leaves, bark, stem, and stone of chokecherry become toxic. Only the meaty flesh of the fruit is not toxic (Kindscher 1987, USDA NRCS n.d.).

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Photos 1, 2,4: Wild Rose Consulting, Inc.
Photo 3: Collin Stone.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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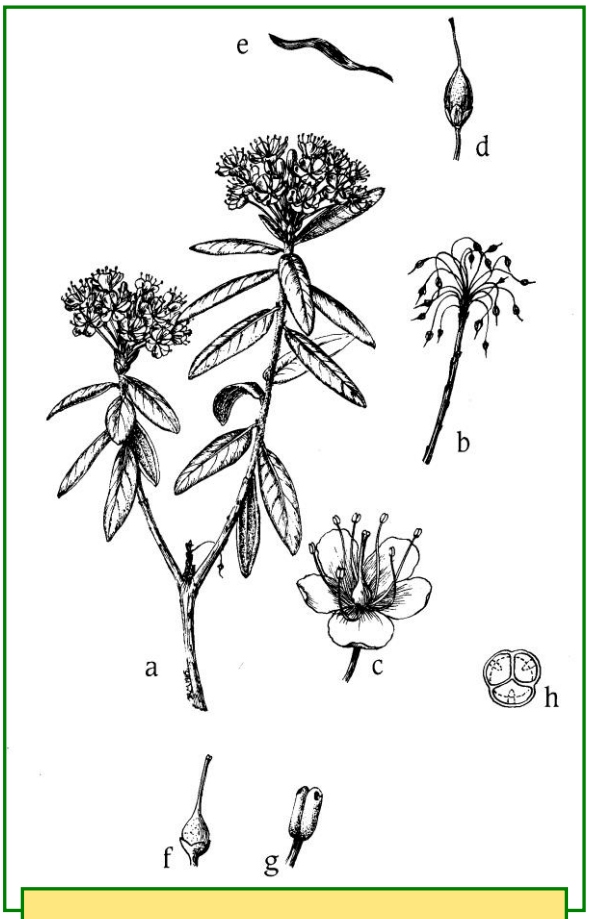
Scientific Name: *Rhododendron groenlandicum* Oeder.
Family: *Ericaceae*

Common Names: Labrador tea, bog Labrador tea, rusty Labrador-tea, St. James' tea, marsh tea, swamp tea, Hudson's Bay tea



Rhododendron groenlandicum **a. flowering branch b. seed head c. flower d. individual capsule e. seed f. stigma g. anther h. pollen.**

Plant Description

Perennial, erect, aromatic shrub, 30 to 80 cm high, rhizomatous, 15 to 48 cm deep (Flinn and Wein 1977, Viereck and Schandelmeier 1980); soil and moisture characteristics greatly influence length and depth of rhizomes (Gucker 2006); leaves alternate, oblong to elliptic evergreen, 1 to 5 cm long, deep green above and densely rusty-tomentose beneath; terminal umbel of white flowers, each 5 to 8 mm long.

Fruit: Puberulent, oval to oblong capsules 5 to 7 mm long, in clusters (Gray 2011, Gucker 2006).

Seed: 2 to 3 mm long, needle-shaped, straw-coloured, central embryo darker, striate to wavy texture (Gucker 2006).

Rhododendron groenlandicum **plant in flower.**

Habitat and Distribution

Commonly found in acidic and moist organic substrates such as bogs, muskegs, swamps and wet coniferous woods.

Soil: Tolerant of acidic and infertile soils (Tannas 1997). In areas of pH ranging from 2.9 to 6.9 (Gucker 2006).

Established in well drained to poorly drained soils (Gucker 2006).

Distribution: Found in northern Alberta, Rocky Mountains, southwestern Alberta and west-central Alberta. Widespread in the northern parts of the circumpolar boreal forest, sub arctic and arctic

tundra. Alaska, Yukon, District of Mackenzie to Hudson bay, northern Quebec, Newfoundland south to Oregon, British Columbia, Alberta, Saskatchewan, Manitoba, Great Lakes, Pennsylvania, New Jersey (Moss 1983).

Rhododendron groenlandicum **inflorescence.**

Phenology

Flowers late May to early June. Fruits ripen late August to fall (Gucker 2006).

Pollination

Self and cross pollinated by a variety of insects including *Apis*, *Bombus* and *Andrena* in particular (Reader 1977).
Possibly wind pollinated (Knuth 1909).

Seed Dispersal

Seed are very small and are easily dispersed by wind (Gucker 2006).

Genetics

2n=26 (Moss 1983).

Symbiosis

Forms ericoid mycorrhiza with a diverse assemblage of fungal endophytes (e.g., *Hymenoscyphus ericae*) (Hambleton et al. 1999, Massicotte et al. 2005).
R. groenlandicum is a host of the root endophytic fungus *Phialocephala fotinii* (Addy et al. 2000).

Seed Processing

Collection: Capsules are easily plucked from the low bushes.
Seed Weight: 0.01 to 0.04 g/1,000 seeds (0.02 average).
Harvest Dates: Late August. September 1 to September 30 (Formaniuk 2013).
Cleaning: Air-dry fruits. Remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens (0.85 mm). Small chaff and dust can be removed by winnowing. If capsules are intact merely open capsules and empty seeds; sieve or winnow to remove chaff and dust.
Storage Behaviour: Orthodox, seeds can be dried, without damage their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store dry (Karlin and Bliss 1983). Due to growth need of light, small seed size and observed decreasing growth productivity with increasing age, potential for seed banking is limited (Gucker 2006). 100% viability following drying to a moisture content of 15% and freezing for 1 month at -20º C (Royal Botanic Gardens Kew 2008).
Longevity: Usually does not exceed 1 year (Karlin and Bliss 1983).
Up to 3 years in a cool dry plastic sealable bag (Schultz et al. 2001).

Propagation

Germination: Seed germination decreases with age. Fresh seeds: 58% in 25 days. Stored seeds: 16 % after 1 year; up to 1 year old (Karlin and Bliss 1983). Smreciu et al. (2008) found similar results in

northeastern Alberta populations: 29% in 30 days with fresh or 1 year old seeds but not 2 year old seeds.
100% germination occurred when seeds germinated on a 1% agar media at temperatures of 30°C (8 hours day/16 hours night) (Royal Botanic Gardens Kew 2008).
Pre-treatment: No stratification required (Formaniuk 2013); 30 days cold stratification (Wood pers. comm.).
4 weeks cold stratification (Nichols 1954). Karlin and Bliss (1983) concluded that germination occurred without cold stratification.
Relatively high constant temperatures (15 to 19°C) are required for germination.
Germination rates increase in the presence of light.
Germination and establishment in water-saturated substrates can occur, however seedlings will most likely be short-lived because of the small-size and slow growth rate of the seedlings (Karlin and Bliss 1983).

***Rhododendron groenlandicum* seed.**

Direct Seeding: No significant emergence observed, only small seedlings observed after 5 years on reclaimed oil sands sites in northeastern Alberta.
Vegetative Propagation: Rhizome division may be possible.
Cuttings (taken in mid-December) root well (Dirr and Heuser 1987). Calmes and Zasada (1982) found cuttings taken in July and kept outdoors to be the most productive (Gucker 2006).
Layering occurs naturally and is an effective manner in which the plant establishes itself in an area (Gucker 2006).
Greenhouse Production: Gucker (2006) found that best growth occurred at a pH of 5.5, less growth at a pH of 3.5 and no growth at a pH of 8.5. Best growth in lighted areas of peat and or moss substrates (Gucker 2006).
Greenhouse Timeline: 26 weeks in the greenhouse until out-planting. Can be over wintered for a spring or fall planting the following season (Wood pers. comm.). Grow for 180 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Used as tea (Gray 2011, Marles et al. 2000, Turner 1997, Wilkinson 1990). Drinking the teas has been said to cause dizziness and drowsiness and diarrhoea so caution is advised (Gray 2011, Wilkinson 1990). Can be used as a substitute for bay leaf in stews, sauces and soups (Gray 2011).
Berries stewed and served with smoked fish (Royer and Dickinson 1996).
Medicinal: Source of vitamin C (Gray 2011). The leaves (chewed or made into tea) can treat stomach flu, chills, pneumonia, headaches, diarrhoea, heart ailments, arthritis, whooping cough, teething pain, kidney ailments, and relieve tension. Powdered leaves relieve burns and eczema. Leaf decoctions can be used as an eye-wash to relieve dry eyes (Royer and Dickinson 1996, Turner 1997). Boiled whole plants can treat chest pains and hair loss. Branches can act as an antibiotic against *E. coli* and *Bacillus subtilis* (Gray 2011). Peeled root decoction is used to treat colds and clean out stomach (Marles et al. 2000).
Other: Berries provide a red dye (Royer and Dickinson 1996). Crushed leaves act as an insect repellent and can help deter rodents from foodstuffs (Gray 2011).

Wildlife/Forage Uses

Wildlife: Leaves and twigs are browsed by caribou and moose although it is a minor component in the

diet (Gucker 2006). Unpalatable to snowshoe hares and other rodents because of the presence of germacrone concentrations (known as a chemical defence) in the leaves and internodes of the plant (Reichardt et al. 1990).
Provide cover for a wide range of small wildlife species (Gucker 2006).
Livestock: Unpalatable to livestock (Tannas 1997). Contains component considered toxic to livestock (Gucker 2006).
Grazing Response: Moderate tolerance to browsing (Tannas 1997).

Reclamation Potential

Naturally re-colonizes sites disturbed by logging, burning and mining (Gucker 2006). Found to re-establish naturally in areas previously disturbed by road construction or fire (Gucker 2006).
Shows greater reproductive effort in disturbed sites as opposed to undisturbed sites (Gucker 2006).
May act as a indicator to sites contaminated with lead (Pugh et al. 2002).
Useful in revegetation of fertile soils (Tannas 1997).

Commercial Resources

Availability: Labrador tea is available commercially in plant form in Alberta, but not widely.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: None are known.
Uses: Essential oil for aromatherapy, ornamental shrub.

Notes

Synonyms – *Ledum groenlandicum* Oeder.
R. groenlandicum is listed as 96% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Re-establishes itself rapidly following fire due in part to the high temperature requirements for germination (Karlin and Bliss 1983).

Photo Credits

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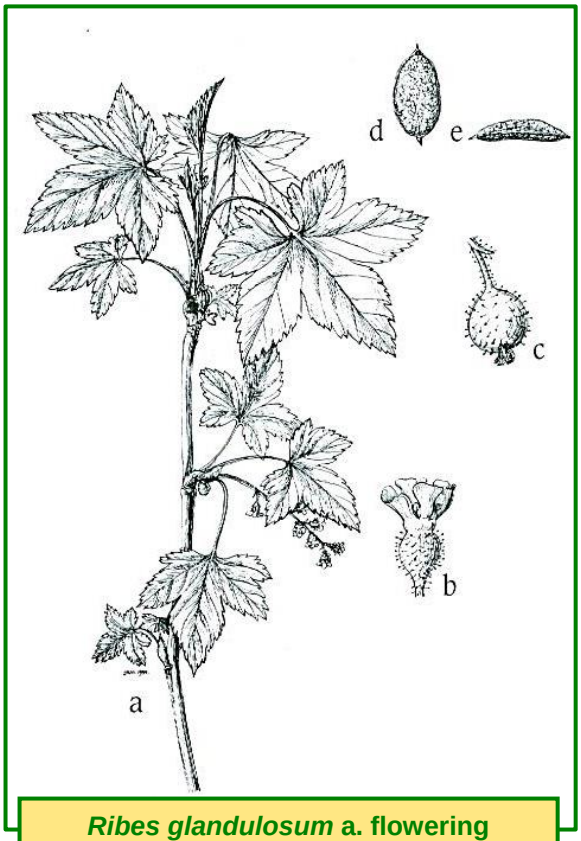
Scientific Name: *Ribes glandulosum* Grauer Family: *Grossulariaceae*

Common Names: skunk currant, skunk red currant, skunkberry, fetid currant



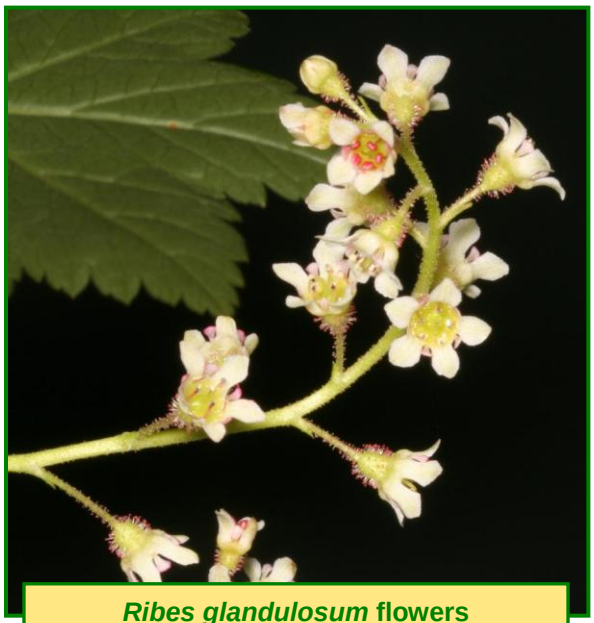
***Ribes glandulosum* a. flowering branch with leaves b. flower c. fruit d. seed**

Plant Description

Deciduous shrub, stems up to 1 m long, spreading; bark purplish brown to grey; skunk-like odor when bruised; leaves alternate, 2 to 8 cm long, 2 to 7 cm across, 5 to 7 lobes, underside with glandular hairs; flowers are white or reddish, 2 to 2.5 mm long with 5 petal and 5 sepals (Royer and Dickinson 2007).
Fruit: Dark red berry, bristly, about 6 mm across (Royer and Dickinson 2007).
Seed: Irregular, generally ovoid, reddish brown seed with rough texture. Approximately 1 to 1.5 mm long.

Habitat and Distribution

Ribes glandulosum is found in moist woodlands and clearings (Moss 1983).
Seral Stage: Found on edges, likely early seral.
Soil: *Ribes sp*. prefer cool moist soil, well drained clay loam; pH 6 to 7.5 (Alberta Agriculture 1993).
Distribution: Alaska, Yukon, southwestern District of Mackenzie to James Bay, northern Quebec, Newfoundland south to British Columbia, Alberta, Saskatchewan, Manitoba, Great Lakes, New York; North Carolina (Moss 1983).



***Ribes glandulosum* flowers**

Phenology

Flowers bloom May to July. Fruit ripen from July to September (Young and Young 1992).

Pollination

The majority of pollination is done by insects (McGregor 1976).

***Ribes glandulosum* seed**

Seed Dispersal

Animal dispersed by numerous predators (Ulev 2006).

Genetics

2n=16 (Moss 1983).

Symbiosis

None known.

Seed Processing

Collection: The fruit should be picked off the shrub as soon as they are ripe to reduce losses due bird and animal consumption (Young and Young 1992).
Seed Weight: 0.87 g/1,000 seeds.
Fruit/Seed by Weight: 91,000 seeds/kg of berries.
Fruit/Seed by Volume: 44,000 seeds/L of berries.
Average Seed/Fruit: 14.
Harvest Dates: End of July or early August.

Cleaning: Seeds should be macerated and the seeds recovered by floatation (Young and Young 1992).
Storage Behaviour: Unknown. Likely orthodox: seeds can be dried prior to cold storage.
Storage: Dried seeds can be stored for long periods in sealed vials at low temperature (Young and Young 1992).
Longevity: Can remain viable for 17 years under "normal storage" conditions (Plants for a Future n.d.).

Propagation

Natural Regeneration: Reproduces by seed and vegetatively by layering (Ulev 2006).
Germination: Germination percentages are low despite long periods of cold stratification.
Pre-treatment: *Ribes* spp. are usually highly dormant and require a cold stratification followed by a warm stratification followed by a second cold stratification (Young and Young 1992).
Direct Seeding: *Ribes* seeds are usually sown in the fall and covered with 0.6 cm of mulched soil (Young and Young 1992).
Seed Rate: 630 to 830 seeds/m² (Young and Young 1992).

***Ribes glandulosum* shrub with ripe berries**

Vegetative Propagation: Can reproduce by layering. Cuttings can be taken in the fall after the leaves have dropped (Alberta Agriculture 2000). Make cuttings 20 to 25 cm long; lower cut should be right below a bud and the upper cut should be diagonal and about 1 cm above the top bud. Store the cuttings in a cold frame under 30 cm of soil (Alberta Agriculture 2000).
Plant early in the spring in 20 cm wide trench. Plant 15 cm apart by laying them in the trench so that a single bud is above the soil. Keep the soil moist to encourage rooting (Alberta Agriculture 2000).

Aboriginal/Food Uses

Food: Currants can be eaten fresh or cooked to make jelly (Marles et al. 2000). The stems of the plant can be made into a bitter tea (Marles et al. 2000).
Medicinal: A decoction of the stem was given to prevent blood clotting after birth (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: *Ribes* spp. are used as food by wildlife, including rodents, birds and hooved browsers. It is used as shelter for many smaller animals (Ulev 2006).
Livestock: *Ribes* spp. can be poor to fair forage for livestock (Ulev 2006).

Reclamation Potential

As an edge species, *Ribes glandulosum* could make a good candidate for reclamation.

Commercial Resources

Availability: Not available commercially in Alberta (ANPC 2010).
Uses: No known commercial uses.

Notes

R. glandulosum is listed as 93% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Ribes species including *R. glandulosum* are the initial host to the blister rust fungus (*Cronartium ribicola*) as part of a two stage cycle which ends in the fungus infecting white pine, which can eventually kill the tree (Zambino 2010).

Photo Credits

Photo 1 and 2: François Gros d'Aillon. Professeur honoraire de l'UQÀM.
Photo 3: Wild Rose Consulting, Inc. 2011.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Ribes hudsonianum Richards.*

Family: *Grossulariaceae*

Common Names: northern black currant, black currant, Hudson Bay currant

Plant Description

Erect to ascending, deciduous shrub with a sweet "tomcat" odour, 50 to 150 cm tall; branches smooth (no prickles), with yellow, crystalline resin dots; leaves alternate maple leaf-like with 3 to 5 lobes, usually 5 to 7 cm wide, sharply toothed, dotted with yellow resin glands (Kershaw et al. 1998).

Fruit: Black berries with a whitish, waxy bloom, usually speckled with a few yellow resin dots, 5 to 10 mm wide (Kershaw et al. 1998).

Seed: An oval seed that is approximately 1.7 mm by 1 mm (Young and Young 1992).

Ribes hudsonianum in flower

Habitat and Distribution

Moist woods, forests, stream banks (EFloras 2010, Moss 1983).

Seral Stage: Mid to late seral.

Soil: Does best in medium to coarse textured soils with a pH tolerance 5 to 6.9 and no salinity tolerance (USDA NRCS n.d.).

Distribution: Alaska, Yukon, southern District of Mackenzie to James Bay south to Washington, Idaho, western Montana, Alberta, Saskatchewan, Manitoba, Minnesota, southern Ontario (Moss 1983).

Phenology

Flowers May through July (Young and Young 1992).

Pollination

Plants cannot self-pollinate. Insects are the primary pollinator but wind pollinates flowers as well (Plants for a Future n.d.).

Genetics

2n=16 (Moss 1983).

Symbiosis

Some *Ribes* spp. have been shown to have mycorrhizal relationships (Cornelissen et al. 2001).

Seed Processing

Collection: Collect by hand when ripe. The berries should be picked or stripped from the bushes as soon as they are ripe because they are quickly eaten by wildlife (Young and Young 1992).

Seed Weight: 0.73 g/1,000 (Royal Botanic Gardens Kew 2008).

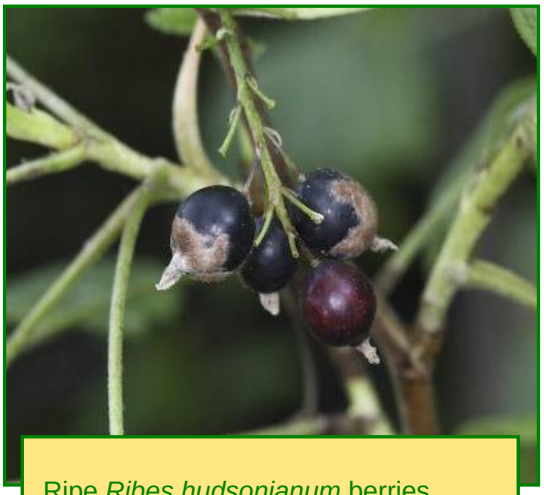
0.47 g/1,000 seeds (Young and Young 1992).

Fruit/Seed by Weight: No literature found.

Harvest Dates: Seed crops are born every year but every 2 to 3 years there is a bumper crop (Young and Young 1992).

Cleaning: Seeds can be cleaned using a blender with protected blades but the risk of seed damage can be greatly reduced if the fruit are mashed with pectinase, instead. The mixture is flocculated and floating seeds

(generally nonviable) are discarded (Hummer and Barney 2002).
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: Store at cool temperatures at sealed containers (Young and Young 1992).
Seeds are air dried, placed within a desiccator, and stored in paper or aluminium foil envelopes at -20°C (Hummer and Barney 2002).
Longevity: Dried seeds can be stored in sealed containers (Young and Young 1992).



Ripe *Ribes hudsonianum* berries

Propagation

Natural Regeneration: Regenerates mainly by seed and has moderate vegetative spread (USDA NRCS n.d.).
Germination: Epigeal germination. The rate of germination for *Ribes* spp. varies widely with and among seedlots (Young and Young 1992).
Daily alternating temperatures increase germination rates and percentages (Hummer and Barney 2002).
Pre-treatment: Most *Ribes* spp. are highly dormant and require a prolonged cold stratification, then a warm stratification, followed by a cold stratification (Young and Young 1992).
Place in cold moist stratification for 90 to 120 days (Baskin and Baskin 2002).
For optimal germination, seeds are stratified at 4 °C for 3 months before sowing (Hummer and Barney 2002).
Direct Seeding: No literature found.
Seed Rate: Should be sown at a rate 630 to 840/ m^2 (Young and Young 1992).
Planting Density: 3,000 to 4,700 plants/ha (USDA NRCS n.d.).
Vegetative Propagation: Most species of *Ribes* can be reproduced by hardwood cuttings and layering (Tannas 1997, Young and Young 1992). Semi-hardwood cuttings, 1 to 15 cm, taken in July and August or hardwood cuttings, with heel, taken in the winter may be successful (Plants for a Future n.d.).

Aboriginal/Food Uses

Food: Eaten fresh, cooked for jam, salads, wine; flavour home brew (Marles et al. 2000).
Medicinal: Boiled leafy stems decoction can be drunk to treat a cough or sickness at childbirth as well as to bring on menstruation (Marles et al. 2000). A tea made from wild black currant and skunk currant can help a woman to conceive (Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Birds and smaller animals eat the berries. Plant makes a poor quality browse (Tannas 1997). Favoured by bears, grouse and songbirds (Wilkinson 1990).
Livestock: Poor quality browse and generally not used if there are better food sources available (Tannas 1997).
Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

Ribes spp. can be used for erosion control in areas that have good moisture conditions; have moderate tolerance to acidity (Tannas 1997).

Notes

Ribes hudsonianum is listed as 98% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Many species of *Ribes* are a host to white pine blister rust (Young and Young 1992).

Photo Credits

Photos: Walter Muma @ Ontario Wildflowers. 2011.

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Scientific Name: *Ribes lacustre* (Pers.) Poir. **Family:** *Rosaceae*

Common Names: bristly black currant, prickly currant, swamp currant

Plant Description

Erect to spreading shrub, 30 to 150 cm tall; branches are bristly, often with 1 to 3 spines up to 1 cm long at nodes; older bark whitish grey; leaves are somewhat maple-like, 3 to 4 cm across, 3- to 5-lobed, squared to slightly heart-shaped at the base, usually has gland-tipped hairs below; edges irregularly round-toothed; flowers 1 to 3 drooping clusters; greenish yellow to whitish, bell-shaped at the base, usually has gland-tipped hairs below, edges are irregularly toothed (Royer and Dickinson 2007).
Fruit: Smooth berries, reddish to bluish purple, 10 to 15 cm across; edible (Royer and Dickinson 2007).
Seed: Seed is reddish, flat, oblong to tear drop shaped approximately 2.5 x 1.5 mm.

***Ribes lacustre* branch with flowers**

Habitat and Distribution

Open woods and exposed rocky sites (Johnson et al. 1995).
Seral Stage: Is found in all stages of development (Carey 1995).
Soil: Mesic to subhydric regimes; medium to rich nutrients; pH 5.9 to 7.8 (Beckingham and Archibald 1996, USDA NRCS n.d.).
Distribution: Alaska, Yukon, southwestern District of Mackenzie to James Bay, Newfoundland, south to California, Utah, Colorado, South Dakota, Michigan, Pennsylvania (Moss 1983).

Phenology

Flowers from April to July with fruit ripening August (Young and Young 1992).

Pollination

Wind and insect pollinated (Bonner and Karrfalt 2008).

Dispersal

Birds are the main agents of seed dispersal; tests show that some *Ribes* seeds germinate better after passing through certain bird species (CYSIP: Botany n.d.).

Genetics

2n=16 (Moss 1983).

Seed Processing

Collection: Berries should be picked as soon as they are ripe to avoid losses of seed by birds and other wildlife (Young and Young 1992).
Seed Weight: 0.88 g/1,000 seeds (Young and Young 1992).
0.96 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: End of July to August (Young and Young 1992).
Cleaning: Maceration and washing are used to separate seed from the pulp. A kitchen blender may

be used for small seed lots (Bonner and Karrfalt 2008).
Storage Behaviour: Likely orthodox; seed should be dried to low relative humidity prior to cold storage (Royal Botanic Gardens Kew 2008).
Storage: Store in sealed containers with a low moisture content; temperature is not important (Bonner and Karrfalt 2008).
Longevity: *Ribes* spp. have been reported to remain viable up to 17 years (Bonner and Karrfalt 2008).

Propagation

Natural Regeneration: Mainly by seed (Bonner and Karrfalt 2008).
Germination: 79% germination was reported for *Ribes laucustre* in test conditions (Bonner and Karrfalt 2008).
Germination is epigeal (Young and Young 1992).
Pre-treatment: Cold stratification 0 to 5°C for 90 days (Bonner and Karrfalt 2008).
Seed Rate: Plant between 3,162 plants/ha and 12,651 plants/ha (USDA NRCS n.d.).
Vegetative Propagation: Hardwood and semi-hardwood cuttings can be rooted (Dave's Garden n.d.).

Cleaned *Ribes lacustre* seeds

Aboriginal/Food Uses

Food: Can be eaten fresh or made into jam (Marles et al. 2000). Spines can be singed off leaves and stems and then combined with bark to make a tea (called catnip tea)(Turner 1997).
Medicinal: Stem tea can be drunk as a treatment for diarrhoea and colds, and leaf tea was drunk to prevent miscarriages (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Berries eaten by bears, birds and small rodents (Tannas 1997).
Livestock: Poor browse for livestock (Tannas 1997).
Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

Could be used to prevent erosion and stabilize slopes (Tannas 1997).
Germinates from seed bank after fire (Hamilton 2006)

Commercial Resources

Availability: Very limited availability in Alberta (ANPC 2010), seed should be collected from native populations.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: No literature found.

Notes

Ribes lacustre is listed as 84% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Distinguishable from other *Ribes* spp. by persistent prickles on the stem and its bristly fruit (Borealforest.org n.d.).
Bristles may cause an allergic reaction in some sensitive people (Wilkinson 1990).

Photo Credits

Photo 1: Walter Siegmund @ Wikipedia commons 2011.
Photo 2: Steve Hurst @ USDA-NRCS PLANTS Database 2011.

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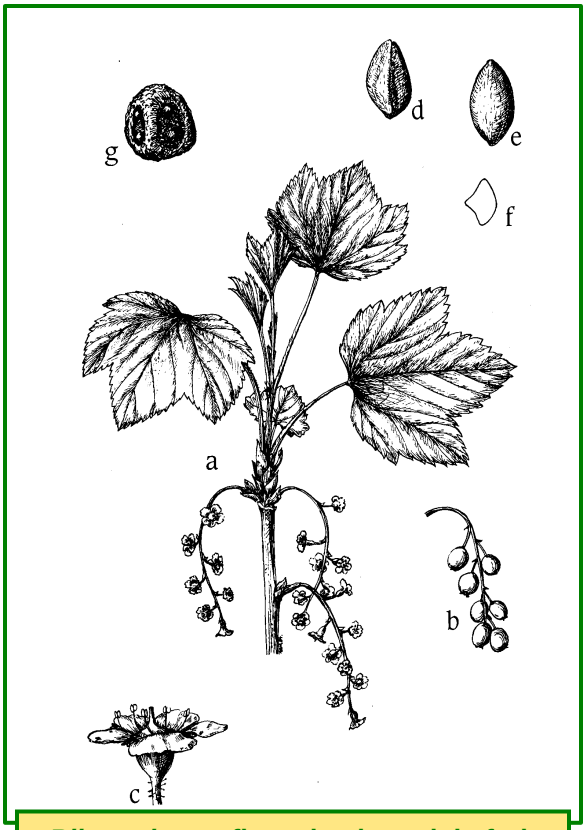
Scientific Name: *Ribes triste* Pallas **Family:** *Grossulariaceae*

Common Names: swamp red currant, red currant



***Ribes triste* a. flowering branch b. fruit c. flower d–f. seeds g. pollen**

Plant Description

Reclining to ascending shrub, up to 1 m tall; branches do not have prickles; leaf palmate, 3 lobed (rarely 5 lobed) shallowly heart shaped or rarely squared at the base; lobes broadly triangular, toothed, maybe hairy below; flowers borne in drooping racemes; reddish or greenish purple, flower stalks are jointed and usually bear gland tipped hairs (Moss 1983).

Fruit: Bright red, smooth berries, about 6 mm across, edible sour (Johnson et al. 1995).

Seed: Seeds are reddish 1 to 2 mm x 1 to 2 mm long, ovoid to round.

Habitat and Distribution

Moist woods, clearings, rocky slopes and swamps in the aspen parkland and boreal forest (Marles et al. 2000).

Seral Stage: Varies from early to climax communities in its range (Ulev 2006).

Soil: Soil pH range between 5 and 7.5 with no tolerance to salt. Soils can range from well to poorly drained coarse and medium textured soil (USDA NRCS n.d.).

Distribution: Alaska, Yukon, northern District of Mackenzie to Hudson Bay, northern Quebec, Newfoundland south to Oregon, Alberta, Saskatchewan, Manitoba, North Dakota, Minnesota, New Jersey (Moss 1983).

***Ribes triste* with ripening berries**

Phenology

Flowers appear in late May to early June (Johnson et al. 1995). Berries appear July to August (Ulev 2006).

Pollination

Bees are the main pollinators of all *Ribes* species; they gather both nectar and pollen (CYSIP: Botany n.d.). *Ribes* spp. are often wind pollinated (Ulev 2006).

Seed Dispersal

Animal dispersed by numerous predators (Ulev 1990), especially birds (CYSIP: Botany n.d.).

Genetics

2n=16 (Moss 1983).

Seed Processing

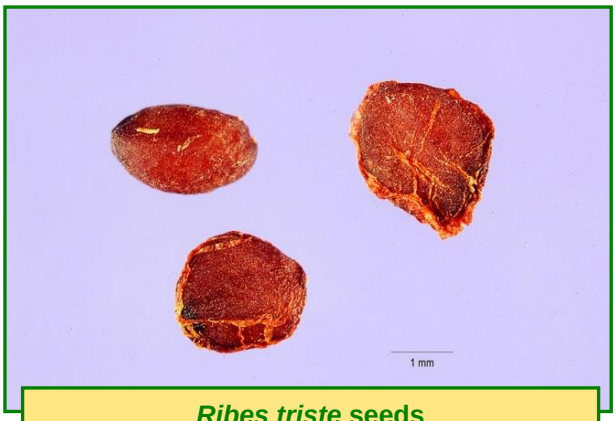
Collection: The fruit should be stripped or picked as soon as they are ripe to avoid losses to birds and other wildlife (Young and Young 1992).
Seed Weight: 3.2 g/1,000 seeds.
Harvest Dates: July to August (Ulev 2006).
Cleaning: *Ribes* spp. seeds can be cleaned by maceration and floatation (Young and Young 1992).
Storage Behaviour: Unknown. Likely orthodox, tolerant of drying prior to cold storage.
Storage: *Ribes* spp. seeds can be stored for long periods of time in sealed containers at low temperatures (Young and Young 1992).
Longevity: Marked decline in viability after one year of seed stored at room temperature.

Propagation

Natural Regeneration: By seed and very likely vegetative though the latter is not definitive (Ulev 2006).
Germination: Epigeal (cotyledons above ground) germination (Young and Young 1992).
Nichols (1934) found that a greater percentage of seeds germinated without refrigeration. They also germinated more quickly without stratification.
Pre-treatment: *Ribes* spp. seeds are dormant and require a prolonged stratification and/or a wide variety of diurnal temperatures in order for the seeds to germinate (Young and Young 1992). However, Nichols (1934) found stratification unnecessary.
Direct Seeding: Sow at a depth of 0.6 cm in mulched seedbeds (Young and Young 1992).
Seed Rate: *Ribes sp*. seeds should be sown at a rate of 630 to 340 seeds/m^2 (Young and Young 1992).
Vegetative Propagation: Many *Ribes* spp. can be propagated by hardwood cuttings taken in the fall (Young and Young 1992).

Aboriginal/Food Uses

Food: Berries are eaten fresh or cooked to make jelly (they have high pectin content (Royer and Dickinson 1996)). The stem can be made into a bitter tea (Marles et al. 2000).
Medicinal: Can be used as an eye wash and to bring on menstruation (Marles et al. 2000, Royer and Dickinson 1996, 2007). The berries can help treat yeast infections (Gray 2011).



***Ribes triste* seeds**

Wildlife/Forage Usage

Wildlife: Songbirds, rodents, small and large bears and hoofed browsers (moose, deer etc.) (Ulev 2006).
Livestock: Not used if there is better forage present (Tannas 1997).
Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

Moderately tolerant to acidic soils, *Ribes sp*. do well in medium to coarse textured soil. *Ribes sp.* have

been used for erosion control and to stabilize slopes (Tannas 1997, Ulev 2006).

Commercial Resources

Availability: Not available commercially in Alberta, propagules must be collected from native populations.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.

Notes

Ribes triste is listed as 83% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014). *Ribes* spp. serve as a host and carrier of pine blister rust (Young and Young 1992).

Photo Credits

Photo 1: Courtesy of U.S. Geological Survey Department of the Interior/USGS U.S. Geological Survey 2011.
Photo 2: Tracey Slotta @ USDA-NRCS PLANTS Database.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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CYSIP: Botany, n.d. *Ribes triste:* Wild Red Currant. IN: Central Yukon Species Inventory Project. http://www.flora.dempstercountry.org/0.Site.Folder/Species.Program/Species.php?species_id=Ribes.triste [Last accessed October 8, 2013].

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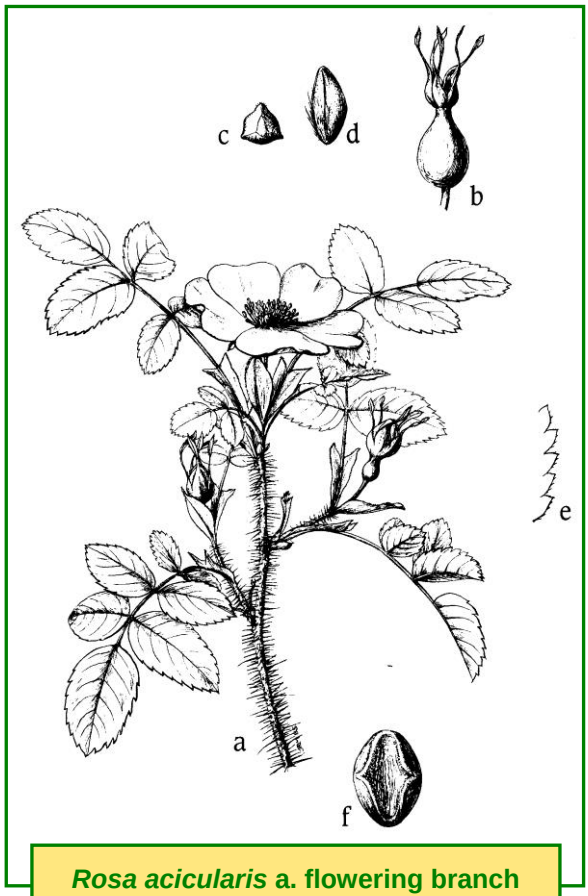
Young, J.A. and C.G. Young, 1992. Seeds of woody plants in North America. Dioscorides Press, Portland, Oregon. 407 pp.

Scientific Name: *Rosa acicularis* Lindl. **Family:** *Rosaceae*

Common Names: prickly rose, bristly rose



***Rosa acicularis* a. flowering branch b. fruit c&d. seeds e. leaf serrations f. pollen**

Plant Description

Low bushy shrub, 0.5 to 1.5 m high, perennial, rhizomatous, roots 20 to 30 cm deep (Viereck and Schandelmeier 1980); stems stout, densely covered with straight slender thorns; compound leaves of 3 to 7 pubescent leaflets, each 3 to 4 cm long sharply double-toothed; single pink flowers 5 to 7 cm across (Moss 1983).

Fruit: Fleshy, red hypanthium, ovoid to pear-shaped or spherical; numerous achenes.

Seed: 3 to 5 mm, straw to golden yellow seeds, angular/planar pear-shaped, smooth to rough textured (Moss 1983).

Habitat and Distribution

Common in open woods and fields throughout the prairies, banks, roadsides and thickets.
Common in the shaded undergrowth of mixed woods and deciduous forests (Hardy BBT 1989).
Soil: Adapted to a wide range of soil moisture and texture conditions. High acid tolerance, flood tolerance and low nutrient soil tolerance (Hardy BBT 1989).
Distribution: Widespread and common across North America, throughout the boreal forest region. Alaska, Yukon, District of Mackenzie to Hudson Bay, Quebec south to British Columbia, Idaho, Montana, Colorado, Nebraska, Iowa, Minnesota, Vermont (Moss 1983).

Phenology

Flowers late May to late June. Fruits ripen from July to August (Crane 1990).

***Rosa acicularis* flower; the floral emblem of Alberta.**

Pollination

Pollinated by bees, butterflies and other insects (Plants for a Future n.d.).

***Rosa acicularis* plant growing on the edge of a forest opening.**

Seed Dispersal

Animal dispersed by numerous predators (Crane 1990).

Genetics

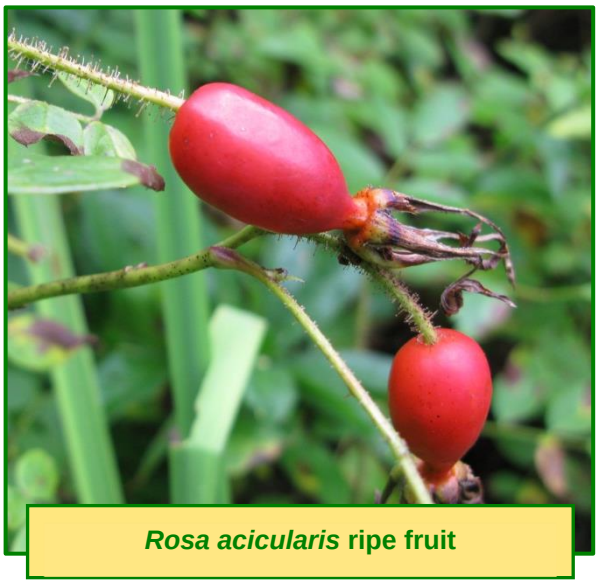
2n=42, 56 (Moss 1983).

Symbiosis

Wasps lay their eggs in the leaves causing gall-like red pincushions (CYSIP: Botany n.d.).

Seed Processing

Collection: Fruit can be easily pulled from branches.
Seed Weight: 10 to 13 g/1,000 seeds (11.8 average).
Fruit/Seed Volume: 380 to 528 fruit/L (458 average); 10,500 seeds/L fruit.
Fruit/Seed Weight: 1,120 to 1,340 fruit/kg (1,190 average); 27,300 seeds/kg fruit.
Average Seeds/Fruit: 23 seeds/fruit.
Harvest Dates: For greater germination, collect fruits when not fully ripe (King 1983). Collect when the hips are bright red or orange-red (Banerjee et al. 2001); approximately late August in northeastern Alberta.
Collect September 1 to February 28 (Formaniuk 2013).
Cleaning: Mash fruit in a sieve (1.40 mm works well). A blender with taped blades may also be used to macerate the fruit. Suspend residue in water allowing seeds to settle. Decant water and chaff. Repeat suspension and decanting until only seeds remain. Alternatively, a tomato de-seeder may be used, as achenes are approximately the same size. Allow seed to dry at room temperature over a moving air stream.
Storage Behaviour: Unknown, likely orthodox allowing seed to be dried prior to cold storage.
Storage: Store dry in sealed containers (Young and Young 1992).



***Rosa acicularis* ripe fruit**

Propagation

Natural Reproduction: By seed and from rhizomes (Hardy BBT 1989).
Germination: Field emergence is more successful than *in vitro* germination. Most seeds take 2 years to

germinate – during the 1st growing season the seeds develop and mature, the next growing season provides the warm stratification period and the subsequent winter provides the cold stratification period. Seeds germinate during the next spring shortly after snowmelt (Densmore and Zasada 1977).
A temperature of 25° C was found to provide the best germination (Baskin and Baskin 2001).
Pre-treatment: Densmore and Zasada (1977) had success with 3 months warm stratification followed by 2 months cold stratification.
Needs 120 day cold stratification before sowing (Wood pers. comm.).
King (1983) recommended 2 months warm stratification followed by 4 months cold stratification.
Formaniuk (2013) recommends 120 days stratification.
Direct Seeding: More than 1% emergence by sowing seeds on oil sands reclamation sites.
Fruit Sowing: Up to 5.3% emergence by year four.
Seeding Rate: 100 seeds/m² and 1.3 fruits/m² to obtain approximately 1 plant/m².
Vegetative Propagation: Spreads naturally by rhizomes (Fedkenheuer et al. 1980). If there is an easily accessible source, using root cuttings for large-scale propagation is feasible. Stem cuttings from dormant hardwood can also be successful if used with a hormone treatment, with coarse material for the rooting media, and heavy watering to maintain high humidity levels (Hermesh and Cole 1983).
Budding, suckers, layering, and grafting (Babb 1959).
Softwood cuttings have been successful (Fung 1984, Smreciu and Barron 1997) especially when treated with 3,000 to 5,000 ppm IBA-talc or K-IBA in water, placed in a peat/perlite medium and kept under mist (Dirr and Heuser 1987).
Greenhouse Timeline: 16 weeks in the greenhouse prior to out-planting. Dormant seedlings can be stored frozen over winter for spring or early fall planting (Wood pers. comm.). Grow for 100 days before harvest (Formaniuk 2013).

Aboriginal/Food Uses

Food: Once seeds are removed, rose hips are eaten fresh (high in vitamin C – Royer and Dickinson 1996, Turner 1997; three rose hips contain as much vitamin C as one orange – Gray 2011). They can be made into a jelly, beverage or syrup. Pink flower petals can be eaten as a treat or made into jelly (Gray 2011, Marles et al. 2000). Seeds are rich in Vitamin E which can be extracted by grinding, boiling and straining and then using in jams (Droppo 1987).
Medicinal: Eaten raw, the fruit can prevent colds; rose petals can be used as a heart tonic and anti-sting; boiled branches can be used for menstrual relief; root decoction can treat diarrhoea, cough, regulate menstruation, and used as eye drops to treat soreness; and the roots as part of a compound medicine can treat chest colds (Marles et al. 2000). A tea brewed from the roots was used to treat diarrhoea (Gray 2011, Wilkinson 1990). Petals used to treat dry skin (Gray 211).
Other: British Columbia tribes used branches for arrows and hollowed stems out to make pipe stems (Wilkinson 1990); others smoked leaves and bark, alone or with other tobacco (Turner 1997).

Wildlife/Forage Uses

Wildlife: Important food source for grouse, snowshoe hares, microtine rodents, and mule deer. In the fall the black bear, grizzly bear, rabbits and beavers eat the fruits, stems and foliage. Coyotes, bears, grouse and other small animals are said to be fond of rose hips (Turner 1997). Small mammals use the thickets for shelter and birds use them for nesting sites and protective cover (Crane 1990).
Livestock: Excellent summer browse for big game and livestock (Crane 1990).
Grazing Response: Resistant to heavy browsing. As a natural self-defence to over-utilization, with time woody growth become less palatable and spines become stiffer, at this point, plants are often avoided (Tannas 1997).
Extensive deer browsing increases shoot production (Smreciu and Barron 1997).

Reclamation Potential

Rosa acicularis is a prolific seed producer in some years especially on open sites. Natural pioneer on disturbed sites where they increase soil stability and control erosion (Tannas 1997). Recommended for revegetation on moist to wet lands in Alaska and Alberta.

Highly adapted to disturbance (King 1983) and a wide range of soil textures and moisture levels.

Proven tolerance to drought on amended oil sand tailings and acidic situations in Alberta (Fedkenheuer et al. 1980).

Spreads rapidly and have shown to recover rapidly following logging (Crane 1990).

***Rosa acicularis* seed**

Commercial Resources

Availability: Widely available from nurseries in Alberta and Saskatchewan.

Uses: Vitamin C, essential oil, floral arrangements and jams.

Notes

Rosa acicularis is listed as 89% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Prickly rose is fire resistant. The deep rhizomes growing in mineral soil make it well adapted for sprouting after a fire (Crane 1990).

Photo Credits

Photo1,2,4: Wild Rose Consulting, Inc.

Photo 3: Qwert1234 @ Wikimedia Commons 2013.

Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Rubus arcticus* L. ssp. *acaulis* (Michx.) Focke
Family: *Rosaceae*
Common Names: dwarf raspberry, arctic blackberry, arctic bramble

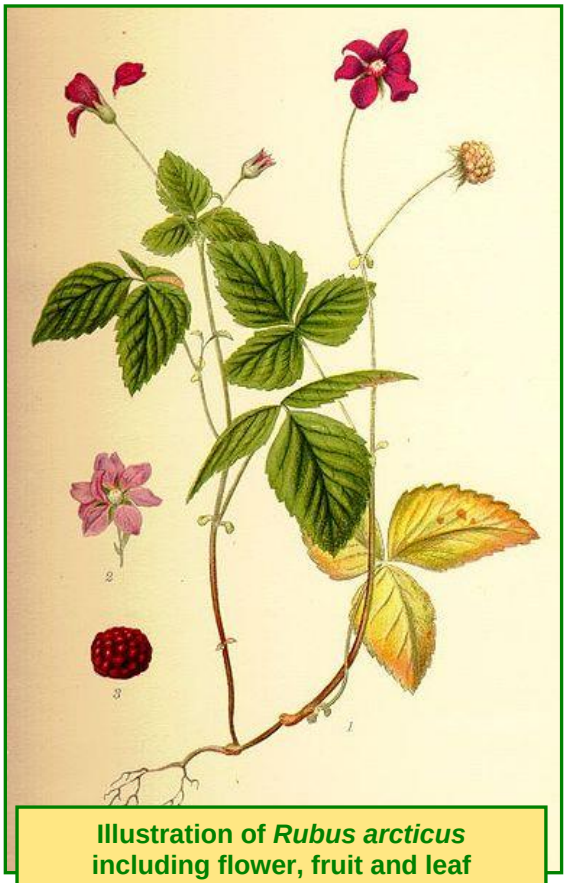


Illustration of *Rubus arcticus* including flower, fruit and leaf morphology.

Plant Description

Low, somewhat tufted perennial from slender creeping rhizomes; flowering stems erect, 5 to 15 cm tall, finely hairy; 2 to 4 leaves round to heart shaped in outline, compound; 3 leaflets, rounded, coarsely toothed, more or less hairy; flowers usually single; showy, pink to reddish pink; petals distinctly narrowed at base (Johnson et al. 1995).
Fruit: Fleshly red drupelets in spherical clusters of 20 to 30 (raspberry) about 1 cm across (Johnson et al. 1995); 1 to 2 aggregates (raspberries) per plant.
Seed: 2.5 to 3 mm x 4 to 5 mm (USDA NRCS n.d.); seeds have an extremely hard seed coat, 0.225 mm thick (Wada and Reed 2011).

Habitat and Distribution

Wet woods, thickets, meadows, peatlands, widespread across boreal forest and northern parkland (Johnson et al. 1995).
Soil: Coarse textured soils, with a pH 5 to 7. No tolerance to drought, salinity or shade (USDA NRCS 2012).
Distribution: Circumpolar. Alaska, Yukon, western District of Mackenzie to Hudson Bay, northern Quebec, Newfoundland south to British Columbia, Montana, Colorado, Saskatchewan, Manitoba, Minnesota, southern Quebec, Gaspe (Moss 1983).

Phenology

Flowering occurs from June to July with berries appearing July to August (Ladyman 2006).

Pollination

Insect pollinated; flowers reported to be self-incompatible (Ladyman 2006).

Genetics

2n=14 (Moss 1983).

Symbiosis

Forms vesicular-arbuscular mycorrhizal associations (Vestberg 1992).

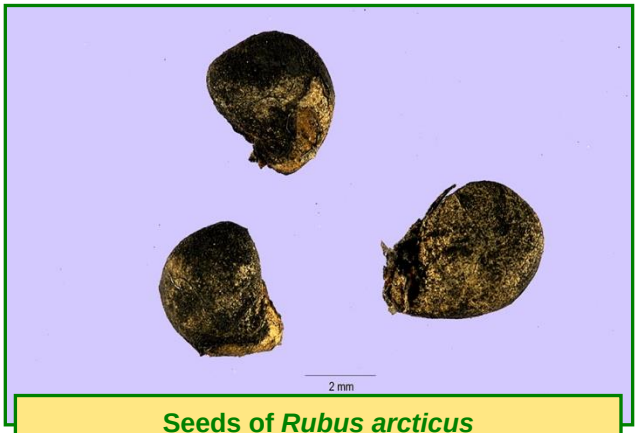
Seed Processing

Collection: Berries should be collected as soon as they are ripe to avoid losses by wildlife consumption (Young and Young 1992).
Seed Weight: Approximately 1.69 g/1,000 seeds (USDA NRCS n.d.).
2.2 g/1,000 seeds (Wada and Reed 2011).

Average Seed/Fruit: 25 seeds per fruit (Bonner and Karrfalt 2008).
Harvest Dates: July through August (Ladyman 2006).
Cleaning: Maceration and floatation to recover seeds; dry completely before storing (Young and Young 1992).
Storage Behaviour: Likely orthodox; dry seed to low relative humidity prior to cold storage.
Storage: Seeds should be dried and stored at low temperatures (Young and Young 1992).
Longevity: *Rubus* spp. remain viable in the soil seed bank for long periods of time (Ladyman 2006) and studies have shown no loss in viability after 26 years of storage (Bonner and Karrfalt 2008).

Propagation

Natural Regeneration: By seeds and by rhizomes (Ladyman 2006).
Germination: Germination is low, less than 40% (Ladyman 2006, Wada and Reed 2011). Germination is epigeal (Young and Young 1992).
Pre-treatment: Seed requires stratification (Plants for a Future n.d.). Stored seed requires one-month stratification at about 3°C and is best sown as early as possible in the year (Plants for a Future n.d.). Sulfuric acid scarification of 30 min is recommended for the small seeded raspberries (*Rubus idaeus* L., *Rubus occidentalis* L.) and up to 3 h for the larger seeded Rubus spp. (Wada and Reed 2011).
Direct Seeding: *Rubus* spp. are best grown under a thin layer of soil and mulch (Young and Young 1992).
Planting Density: 790 to 3,190 plants/ha (USDA NRCS n.d.).
Vegetative Propagation: Division in early spring or just before leaf-fall in the autumn (Plants for a Future n.d.). Larger divisions can be planted out direct into their permanent positions (Plants for a Future n.d.). Plants for a Future (n.d.) found it best to pot up the smaller divisions and grow them in a lightly shaded position in a cold frame, planting them out once they are well established in the summer.
Micro-propagation: Can be micro-propagated (Lindqvist et al. 1998).



Seeds of *Rubus arcticus*

Aboriginal/Food Uses

Food: Berries can be collected and eaten fresh or made in to jam (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Young growth, berries and leaves are eaten utilized by game (Tannas 1997).
Livestock: Not used by livestock if other food sources are available (Tannas 1997).
Grazing Response: Increaser, resistant to moderate browsing (Tannas 1997).

Reclamation Potential

Rubus spp. have been shown to do well after disturbances, especially fire, and are good for erosion control and slope stabilization (Bonner and Karrfalt 2008).
Rubus arcticus is sensitive to low moisture levels and compacted soils (Ladyman 2006).

Commercial Resources

Availability: Not cultivated in Alberta; propagules must be collected from native populations.
Cultivars: There are two commercially-propagated clones only in Finland for use mainly in the liqueur industry they are not suitable for reclamation (Lindqvist 1998).

Notes

Synonyms *Cylactis arctica* ssp. *acaulis*, *Rubus acaulis*, *Rubus arcticus* var. *acaulis* (Lady Bird Johnson Wildflower Center 2007).

There are three subspecies of *Rubus arcticus* – *Rubus arcticus* ssp. *acaulis*, *Rubus arcticus* ssp. *arcticus* and *Rubus arcticus* ssp. *stellatus* (ITIS n.d.) which hybridise between each other as well as with *R. pubescens* (Moss 1983).

Rubus arcticus is listed as 97% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Rubus sp. can live 15 years or more depending on area (Bonner and Karrfalt 2008).

Photo Credits

Photo: Tracey Slotta @ USDA-NRCS PLANTS Database.

Line Diagram: *Rubus arcticus* L. from Bilder ur Nordens Flora. Public Domain. (1917-1926).

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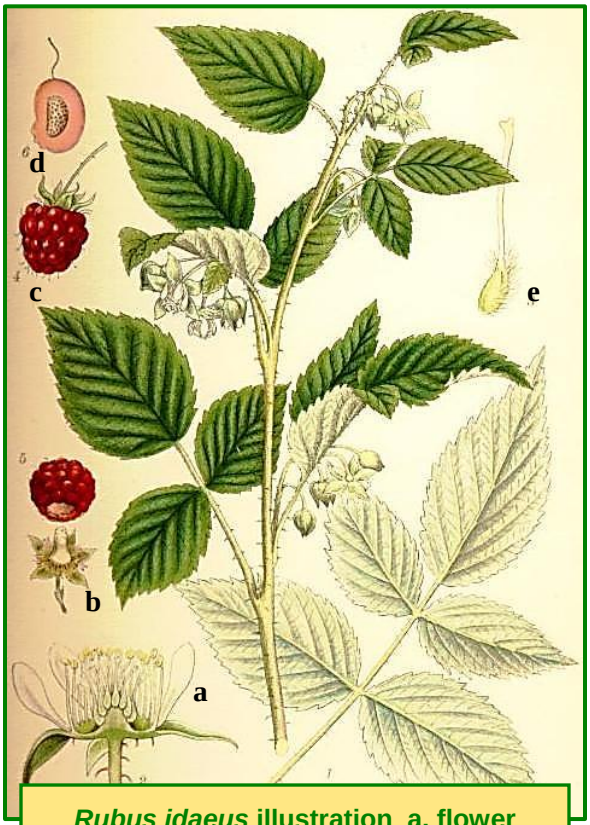
Scientific Name: *Rubus idaeus* L. **Family:** *Rosaceae*

Common Names: red raspberry



***Rubus idaeus* illustration a. flower b. receptacle c. fruit d. druplet e. pistil**

Plant Description

Erect perennial shrub 1 to 2 m high, biennial upright stems (canes), spiny and bristly, often glandular-hairy; bark shredding; leaves of first year stems are pinnately divided into 3 to 5 leaflets ovate to lanceolate, double-serrate margins; leaves of second-year flowering branches are tri-foliate; single or small clusters of drooping white flowers 8 to 12 mm across in a compound cyme (Moss 1983).

Fruit: Red, ovoid, aggregate, 1 cm across, fall intact from dry receptacle (Moss 1983).

Seed: Light brown to pinkish, reniform, with a reticulate surface, 1.5 to 3 mm long (Moss 1983).

Habitat and Distribution

Common in open woods, thickets, clearings, burned-over areas and riverbanks along borders of woodlands, roads and trails.

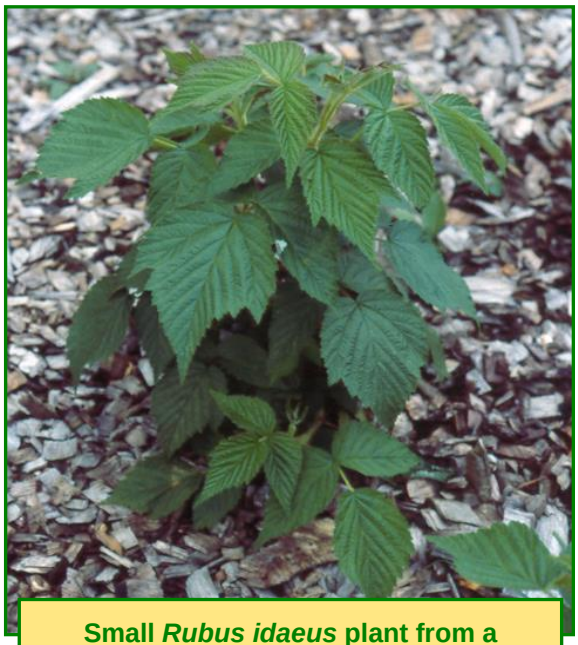
Low shade tolerance (Johnson et al. 1995); tolerant of some shade (Inkpen and Van Eyk n.d.).

Seral Stage: Early seral species that completes its life cycle during the first years following disturbance and becomes a dominant species, but decreases as tree cover increases (Tirmenstein 1990).

Soils: Drought tolerant. Found on fine to coarse soil texture (Gerling et al. 1996).

Grows best on moderately well drained soils and is most abundant on nutrient-rich soils (Tirmenstein 1990).

Tolerates wide range of soil pH (USDA NRCS n.d.). Moderately acid tolerant (Hardy BBT 1989).



Small *Rubus idaeus* plant from a rhizome sprout.

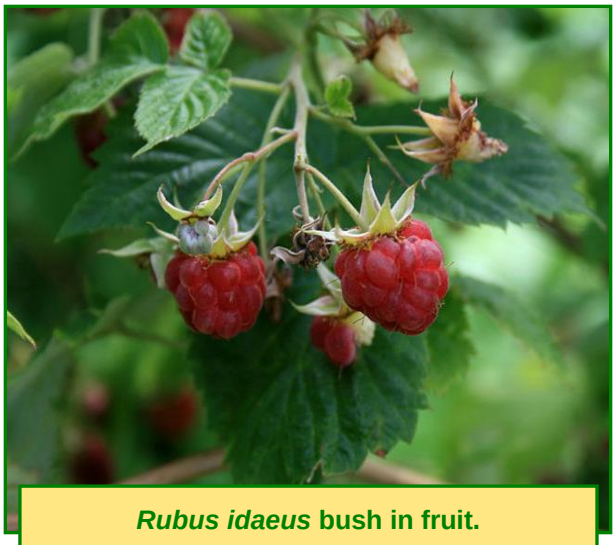
Distribution: Widespread across Alberta. Circumpolar: across Canada, throughout the continental USA (except the southeast), in northern Mexico and in Eurasia (Johnson et al. 1995). Alaska, Yukon, southwestern District of Mackenzie to Hudson Bay, northern Quebec, Newfoundland south to California, Arizona, New Mexico, South Dakota, Missouri (Moss 1983).

Phenology

Flowers late May to July. Fruit matures July through September (USDA NRCS n.d.). Seeds disperse July to October (Brinkman 1964).

Pollination

Pollinated by *Apis*, *Halictidae*, *Syrphidae*, and a variety of other insects (Hansen and Osgood 1983).



***Rubus idaeus* bush in fruit.**

Seed Dispersal

Animal dispersed by numerous predators (USDA NRCS n.d.).

Genetics

2n=14, 21, 28, 35, 42 (Moss 1983).

Symbiosis

Forms vesicular arbuscular mycorrhiza (Currah and Van Dyk 1986).

Seed Processing

Collection: Collection from low branches is more difficult than for some species.
Seed Weight: 14,706 g/1,000 seeds average.
Fruit/Seed Volume: 808 fruit/L average (29,878 seeds/L fruit).
Fruit/Seed Weight: 966 to 1,270 fruit/kg, 1,155 fruit/kg average (42,700 seeds/kg fruit).
Average Seeds/Fruit: 37 seeds/fruit.
Harvest Dates: Late July. July 1 to August 30 (Formaniuk 2013).
Cleaning: Place pulpy fruits in water (use about 3:1 water with fruit) and place in a blender on low speed until fruit is fully macerated. Pour through sieve(s) to remove chaff smaller than seeds. Re-suspend residue in water and mix; allow seeds to settle and decant water with floating and suspended larger chaff. Repeat re-suspension step until seeds are clean; sieve and place seeds on paper towel or cloth to dry. Dry at room temperature or up to 25°C over a moving air stream.
Storage Behaviour: Is thought to be Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store at low temperatures (Young and Young 1992).
Viability maintained for several years in hermetic air-dry storage at 5°C (Royal Botanic Gardens Kew 2008).
Longevity: Seeds can remain viable for 60 to 100 years or more when buried in the soil (Tirmenstein 1990).
According to a one year study, once dried seeds can remain viable for at least one year when stored at 5°C (Hardy BBT 1989).

Propagation

Natural Regeneration: By seed and vegetative reproduction. Reproduces by seeds, root sprouts and stolons (Hardy BBT 1989).

Seedling establishment initiates a stand followed by suckering (Whitney 1982).

Capable of sprouting from axillary buds located above ground level, from aboveground stems, from root crown or stem base (Inkpen and Van Eyk n.d., Tirmenstein 1990).

Germination: >65% germination of fresh and one year old seeds after 60 minutes scarification regardless of stratification.

Brinkman (1964) obtained germination in 30 to 60 days.

Fresh seeds are less likely to germinate (Tirmenstein 1990).

Pre-treatment: 1 hour in 5% sulphuric acid and then a 30 day cold stratification before seeding (Wood pers. comm.).

90 days stratification (Formaniuk 2013).

Young and Young (1992) recommend 120 days cold stratification.

Germination can be improved by treatment with gibberelic acid (Jennings and Tulloch 1964).

Brinkman (1964) suggests 20 to 60 minutes of sulphuric acid scarification followed by 120 days of cold stratification. A combination of warm and cold stratification may be necessary (Brinkman 1964, Dale and Jarvis 1983, Young and Young 1992).

Wild Rose Consulting found seeds from northeastern Alberta did best with a short (<1 hour) acid scarification.

Direct Fruit Seeding: 0.04% emergence of seedlings the first growing season during the spring in the oil sands reclamation area in Fort McMurray.

Late summer or early fall sowing of scarified seeds usually produces the best emergence (Young and Young 1992).

Fruit-Sowing Rate: 25 fruit/m².

Planting Density: 790 to 3,190 plants/hectare (USDA NRCS n.d.).

Vegetative Propagation: Before transplanting, the hardwood cuttings should have a slow release fertilizer added to the rooting medium (USDA NRCS n.d.).

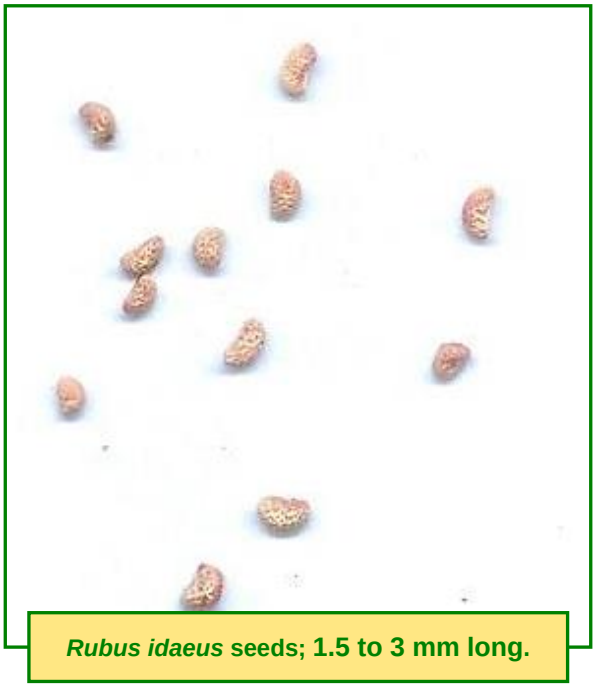
Red raspberry grown from root cuttings in Styroblock containers had a 60% to 80% survival rate and was spreading the first growing season in the landfill revegetation study carried out by Smreciu and Barron (1997).

It has great potential for increased ground cover with its long stolons, tailing stems, or root sprouts.

New plants formed by adventitious shoots can be dug up, when dormant, and transplanted or placed in cold storage until out-planting (Rose et al. 1998).

Micro-propagation: Cultivars of this species can be propagated effectively by tissue culture (Welander 1985).

Greenhouse Timeline: 14 weeks in greenhouse before out planting. Plants can be over wintered for a spring or summer planting (Wood pers. comm.). Grow for 100 days before harvest (Formaniuk 2013).



***Rubus idaeus* seeds; 1.5 to 3 mm long.**

Aboriginal/Food Uses

Food: Fresh and canned fruit eaten or made into syrups (Johnson et al. 1995). Young stems can be peeled and eaten (Wilkinson 1990); older stems and roots are boiled to make a beverage (Marles et al. 2000). Constant food of Aboriginals, settlers, explorers and trappers (Droppo 1987, Turner 1997).
Medicinal: Stems can relieve fevers, childhood diarrhoea, stomach aches, dysentery and cholera, teething, help with recovery from childbirth and be used in eye drop solutions; roots and stems can be used as a wash for infections; and roots can be used in asthma treatment (Johnson et al. 1995). A tea made from the berries and leaves was said to reduce morning sickness; a poultice from leaves and fruit was used to soothe wounds, burns and insect bites (Royer and Dickinson 1996). Leaves can be used to create a women's tonic for all stages of reproduction (Gray 2011).
Other: Fruit used as a dye for clothing and arrow quivers (Wilkinson 1990). Leaves can be used as a facial tonic and to unclog facial pores (Gray 2011).

Wildlife/Forage Usage

Wildlife: Good forage value. Fruits are eaten by grouse, birds, raccoons, coyotes, squirrels, skunks, and chipmunks. Thickets provide shelter for rabbits and squirrels and nesting spots for many birds (USDA NRCS n.d.). New growth, leaves and fruit are readily eaten by game.
Livestock: Poor to fair forage value (Gerling et al. 1996). Wilted leaves have caused livestock fatalities (Wilkinson 1990). Some BC Aboriginal peoples say over-grazing has depleted wild raspberries (Turner 1997).
Grazing Response: Increaser, resistant to moderate browsing pressure. Decreaser when heavy browsed (Gerling et al. 1996).

Reclamation Potential

In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that *R. idaeus* invaded plots rapidly but showed a consistent decline in cover and presence over time. Red raspberry forms thickets and has a rapid cover rate giving it erosion control and soil stability properties.
It is a common invader of disturbed sites such as amended tailings sands and roadsides in northern Alberta. Somewhat drought tolerant and can grow on infertile, bare mineral soil (Hardy BBT 1989). Adapted to a wide range of soil and moisture conditions (Tannas 1997).
Rubus is highly susceptible to damage caused by sodium- and sulphate-enriched consolidated tailings water (Renault et al. 1998). Redfield et al. (2004) found that raspberry exposed to CT had low levels of Na and Cl in roots but elevated levels in shoots causing injury; they recommended planting raspberry in less saline substrates.

Commercial Resources

Availability: Seeds and plants are commercially available in Alberta (ANPC 2010).
Cultivars: Several cultivars are commercially available, but these should be avoided in reclamation situations.
Uses: Red dye (M10), syrups and jams as well as fresh fruit (Marles et al. 2000).

Notes

R. ideaus is listed as 94% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014). After timber harvest or fire, red raspberry usually increases dramatically. It competes vigorously with conifer seedlings (Tirmenstein 1990).

Photo Credits

Photo 1: Mary Hopson, Alaska.
Photo 2: Karelj. http://upload.wikimedia.org/wikipedia/commons/7/7d/Malina.jpg
Photos 3 and 4: Wild Rose Consulting, Inc.
Line drawing: Carl Lindman (1856 to 1928) @ wikimedia commons 2013.

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Scientific Name: *Rubus pubescens* Raf. **Family:** *Rosaceae*

Common Names: dewberry, trailing raspberry, running raspberry

Illustration of *Rubus pubescens*

Plant Description

Trailing perennial, with slender runners, 10 to 100 cm long, rooting at tips; flowering stems erect, up to 30 cm tall, with soft, long hairs; leaves 5 to 15 cm long, compound, 3 leaflets (occasionally 5), oval to diamond spaded, pointed, sharply double toothed; flowers 1 to 3, from crown of plant or from nodes on runners, white to pale pink, erect, stalks often covered with gland tipped hairs; flowers are monoecious (Moss 1983).

Fruit: Fruits dark red, drupelets in clusters (raspberry) about 1 cm across (Johnson et al. 1995).

Seed: Rough, light yellow to brown seed, oval to half moon shape, 2 to 3.5 mm long.

Habitat and Distribution

Rich moist woods and opening (Johnson et al. 1995).

Seral Stage: Mid to late stage.

Distribution: Northern Yukon, District of Mackenzie to James Bay, northern Quebec, Newfoundland south to Washington, western Montana, Saskatchewan, South Dakota, Minnesota, Pennsylvania, New Jersey; Colorado, Nebraska (Moss 1983).

Phenology

Flowers bloom at the end of May into early June and berries appear the end of July to early August.

Pollination

Most *Rubus* spp. are insect pollinated (Bonner and Karrfalt 2008, Plants for a Future n.d.).

Genetics

2n=14, 28 (Moss 1938).

Symbiosis

Many *Rubus* spp. benefit from mycorrhizal associations (Vestberg 1992).

Seed Processing

Collection: Should be collected as soon as they are ripe to prevent losses due to birds (Young and Young 1983).

Harvest Dates: Harvest at the end of July to early August.

Cleaning: Macerate in water, decant, screen, and dry (Young and Young 1992).

Storage: Seeds should be dried and stored at low temperatures (Young and Young 1992).

Longevity: *Rubus* spp. remain viable the soil seed bank for long periods of time (Ladyman 2006) and studies have shown no loss in viability after 26 years of storage (Bonner and Karrfalt 2008).

Propagation

Natural Regeneration: Reproduction mostly vegetative but also by seed (Bonner and Karrfalt 2008).

Pre-treatment: Seeds need to be scarified. This can be done by soaking seed for 20 to 60 min in 1% sodium hyperchlorite solution or sulphuric acid as well as mechanically by nicking the seed coats (Bonner and Karrfalt 2008, Young and Young 1992).

Direct Seeding: *Rubus* spp. germinate best when planted in the fall or late summer (Young and Young 1992).

Vegetative Propagation: *Rubus* spp. can be propagated by tip-layering, rooting suckers, and crown division, and by taking leaf-bud and stem cuttings (Bonner and Karrfalt 2008).

Micro-propagation: Can be micro-propagated (Debnath 2004).

Aboriginal/Food Uses

Food: Berries can be eaten fresh or cooked as jam (Tannas 1994).

Medicinal: Given to mothers before, during and after birth of child to prevent miscarriage, reduce labour pains and increase milk flow (Tannas 1997). Can also be used a laxative (Tannas 1997).

The leaves are astringent and stomachic. A decoction has been to treat the vomiting of blood and blood-spitting. An infusion of the plant, combined with wild strawberry (*Fragaria* spp.), has been used to treat irregular menstruation (Plants for a Future n.d.).

Other Uses: A purple to dull blue dye is obtained from the fruit (Plants for a Future n.d.).

Wildlife/Forage Usage

Wildlife: Fruits are eaten by insects, birds, rodents and bears (Bonner and Karrfalt 2008).

Livestock: Forage is poor to fair, not generally used by livestock (Tannas 1997).

Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that *R. pubescens* did not invade any of the plots. *Rubus* spp. do well on disturbances can be used for erosion control (Tannas 1997). Would make a good groundcover in moist, forested northern landscapes (Lady Bird Johnson Wildflower Center 2009).

Notes

They may hybridise with *R. arcticus* (Moss 1983).

Photo Credits

Photo 1: Tracey Slotta @ USDA-NRCS PLANTS Database.

Line Diagram: *Rubus pubescens* L. from Bilder ur Nordens Flora (1917-1926).

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Scientific Name: *Salix bebbiana* Sarg. **Family:** *Salicaceae*

Common Names: Bebb's willow, gray willow

***Salix bebbiana* leaf and catkin forms.**

Plant Description

Deciduous, perennial, erect shrub or small tree 0.5 to 5 m high, dark reddish brown twisted branches; shallow dense roots; alternate leaves are elliptic to obovate, glaucus beneath, 2 to 9 cm long with margins entire to scalloped; 2 to 9 mm petioled; male and female flowers loosely in catkins (2 to 5 cm long) on separate plants (Moss 1983). Roots shallow and dense (Tesky 1992). Plants live 20 years (Government of the Northwest Territories n.d.).

Fruit: 6 to 9 mm long beaked capsules that split open along 2 sides (Moss 1983).

Seed: 5 to 7 seeds per capsule, which are surrounded by a coma of fine hairs (Zasada et al. 2008).

Habitat and Distribution

Common along shores, forest openings, in thickets and wetlands and also in the tundra. Shade intolerant, grows best in full sunlight (Hardy BBT 1989). Indicator of healthy riparian communities (Hale et al. 2005).

Distribution: Widespread across the northern hemisphere in temperate to arctic zones. Aspen, conifer and mixed wood as well as sand dunes and floodplains. Alaska, Yukon to Labrador, south to California, New Mexico, Indiana, Maryland, Newfoundland (Moss 1983).

Soils: Grows in most textures of soil with a pH ranging from 5.5 to 7.5, preferring moist sandy or gravel soils and will tolerate short periods of inundation. Not drought resistant (Tesky 1992).

Phenology

Flowers from April to August (Tesky 1992).
Flowers May to July, seed ripens June to July.
Fruit ripens quickly after flowering (Tesky 1992).

Pollination

Bees are the main pollinators (Tesky 1992).
Salix species are also pollinated by wind (Macdonald 1986).

Seed Dispersal

Seed attached to pappus for wind dispersal.

Genetics

2n=38 (Moss 1983).

Symbiosis

Host of ectomycorrhizal fungi (Hagerman and Durall 2004).

Seed Processing

Collection: Because *Salix* seeds are quickly dispersed by wind, branches may be cut just before seed dispersal and placed in water and kept in shed for easier seed collection. The seeds are then easily stripped from branches (Macdonald 1986).

Seed Weight: 0.1818 g/1,000 seeds (Young and Young 1992).
Harvest Dates: As soon as ripe (May to June), when the fruit changes from green to yellowish (Young and Young 1992).
Cleaning: Seed does not need to be separated from the capsules (Young and Young 1992).
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Short viability limits storage of seed to 4 to 6 weeks (if seeds are kept moist and refrigerated in sealed containers) although reduction in germination is observed after only 10 days (King 1980).
Simpson and Daigle (2009) found that seed stored at 4°C did not retain seed viability; seed stored at a moisture content between 5% to 10% did best at -20°C for a storage period of 60 months (though not statistically different from the other sub-zero temperatures, -80 to 145°C).
Longevity: Up to 3 years if kept frozen at -10ºC to -20ºC (Densmore and Zasada 1983).

Propagation

Natural Regeneration: Establishes itself by basal stem sprouting, seed, suckers and root (Rawson 1974).
Germination: Fresh, summer-dispersed non-dormant seeds have the best germination percentages (95% to 100%) after 12 to 24 hours at 5ºC to 25ºC, up to 1 week. Moist substrate and light is required (Densmore and Zasada 1983).
Comparing germination of seed in burned and unburned natural areas, seeds in the burned sites had high germination percentages (Baskin and Baskin 2001).
Pre-treatment: None required (King 1980).
Dirr and Heuser (1987) recommend sowing seeds in moist ground immediately after collection.
Direct Seeding: Seeding the fruit was not successful in Northeastern Alberta.
Seed Rate: 3 to 5 catkins/m².

Vegetative Propagation: Softwood cuttings, from tip or base, 20 cm, are more successful than hardwood (Holloway and Zasada 1979).
The cuttings should be planted on sites with sufficient moisture (Tesky 1992).
Cuttings were a successful propagation method on wetland sites in the oil sands reclamation area in Fort McMurray: 10% survival of soft tip cuttings the 1st year and 6% survival the 2nd year; and 21% survival of pole cuttings the 1st year and 16% survived the 2nd year.
A study in Alaska found that *Salix bebbiana* cuttings had difficulty rooting (Holloway and Peterburs 2009).

***Salix bebbiana* catkin**

Aboriginal/Food Uses

Food: Wood can be burned to smoke meat. After boiling the branches twice (first water discarded) can be used to add flavour to home-brew. Flowering branches can relieve diarrhoea, and stomach aches;

inner bark can bring relief to constipation; branches or roots can help sooth toothaches; roots can also relieve fatigue, and stop external bleeding.
Medicinal: Flowering branches can relieve diarrhoea, and stomach aches; inner bark can bring relief to constipation; branches or roots can help sooth toothaches; roots can also relieve fatigue, and stop external bleeding. Prolonged therapy of pain relief by slow release of natural salicylates from willow bark (Johnson et al. 1995).
Other: Various constructive uses such as: pipe stems, bows, canoe ribs, snowshoes, whistles, drumsticks, basket rims, looms, sweat lodge frames, dream catcher frames, rope twine, fishnets, and curling rods for hair (Johnson et al. 1995, Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Major source of browse for moose, elk, bighorn sheep and deer. Small mammals, birds and beaver eat the shoots, buds, and catkins.
Some birds (black-capped chickadees) excavate cavities for nesting. Sapsuckers use the sap extensively (Rawson 1974).
Provides cover and protection for many birds and mammals (Tesky 1992).
Livestock: Because these shrubs grow widely scattered, livestock can easily access them. Forage production is moderate to high. Highly palatable for livestock and big game (Tesky 1992).
Grazing Response: Decreases in response to grazing (Hale et al. 2005). Hardy BBT (1989) indicate high browsing tolerance while Hale et al. (2005) indicate heavy utilization may eliminate the species from riparian areas.

Reclamation Potential

S. bebbiana can be important for revegetation of disturbed sites because of its easy vegetative reproduction and vigorous sprouting under natural conditions (Wilkinson 1990). It is adapted to a broad range of soil surface temperature conditions (Zasada and Viereck 1975) and soil textures (Tesky 1992). It is a relatively good soil and slope stabilizer (Hale et al. 2005, Tesky 1992).

Commercial Resources

Availability: Seeds not commercially available.
Cultivars: None are known.
Uses: Herbal market, wickerwork, and decorative bark with diamond-shaped patterns (canes, lamp posts, furniture, and candle holders). Willow charcoal used in artist's charcoal pencils (Marles et al. 2000).

Notes

Salix bebbiana is listed as 100% intact in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
S. bebbiana has an optimum seed-bearing age of 10 to 30 years (Hardy BBT 1989).

Photo Credits

Photo: Matt Lavan, Wikimedia commons, 2012.
Line diagram: Wikimedia commons, 2012.

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Scientific Name: *Salix exigua* Nutt. **Family:** *Salicaceae*

Common Names: sand bar willow, coyote willow, narrow leaf willow, desert willow

Plant Description

Perennial, erect, colonial shrubs or small trees, 0.5 to 4 m high, spreads by extensive creeping rhizomes that form thickets (Anderson 2006); branches grayish; leaves parallel-sided linear narrow, 5 to 13 cm long (5 to 20 times as long as wide); apex sharply acute, base tapering, shallowly denticulate margins; linear stipules 7 mm long; catkins 1 to 7 cm long borne on leafy branchlets (Moss 1983).

Fruit: Glabrous capsules, 4 to 7 mm long, narrowly ovoid (Moss 1983).

Seed: Non-dormant seeds, 1 to 2 mm long and 4 mm wide attached to the hairs at the radical end, no endosperm (Zasada et al. 2003).

Habitat and Distribution

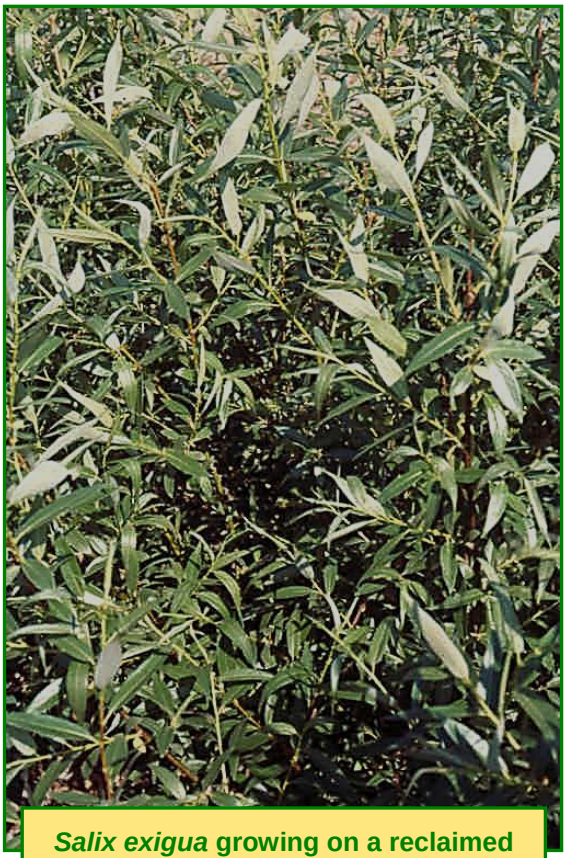
Commonly found in riparian communities (Anderson 2006). Pioneer on slough margins and sandy or gravely floodplains, in wet to moist places along streams, rivers, ditches and roadsides. Intolerant of shade, high tolerance to flooding (Hale et al. 2005). It is the only willow to grow in the lowest and hottest portions of the North American deserts, provided the roots are in moist soil (Anderson 2006).

Soil: Tolerant to a wide range of soil textures and soil types. Bare gravel or sand substrate with adequate moisture (Anderson 2006).

Distribution: Alaska, Yukon, District of Mackenzie to New Brunswick south to California, Texas, Louisiana, Kentucky, and New Jersey (Moss 1983).

Phenology

Flowers May to July, fruit ripens June to July.



***Salix exigua* growing on a reclaimed site in Alberta.**

Pollination

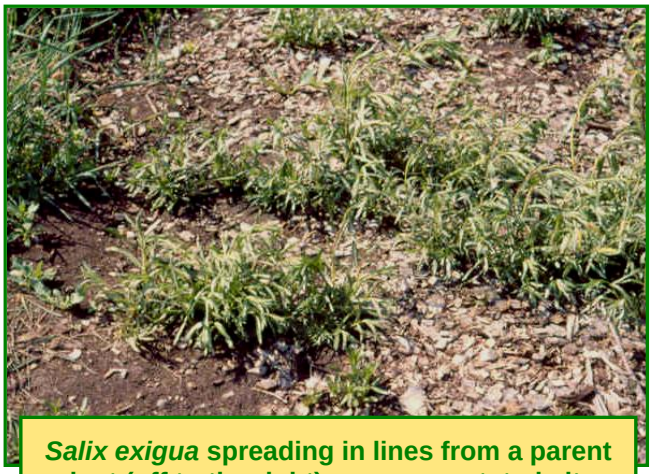
Insects, commonly bees (Anderson 2006). *Salix* species are also pollinated by wind (Macdonald 1986).

Seed Dispersal

Seed are attached to pappus for wind dispersal.

Genetics

2n=38 (Moss 1983).



***Salix exigua* spreading in lines from a parent plant (off to the right) on a revegetated site.**

Seed Processing

Collection: Because *Salix* seeds are quickly dispersed by wind, branches may be cut just before seed dispersal and placed in water for easier seed collection. Seeds are then easily stripped from branches (Macdonald 1986).

Seed Weight: 0.0454 g/1,000seeds (Young and Young 1992).

Seed/Fruit: 25 (15 to 36) seeds/capsule (Zasada et al. 2003).

Harvest Dates: When catkins change from green to yellow-brown (June to July). For most efficient seed extraction, wait until the capsules begin to open (Zasada et al. 2003).

Cleaning: Dried seeds separate from the cotton if tumbled or shaken (Zasada et al. 2003).

Storage Behaviour: Possibly orthodox; seed should be dried prior to storage at freezing temperatures (Royal Botanic Gardens Kew 2008).

Storage: Seed, dried to approximately 6% to 10% of dry weight, can be stored in sealed containers under constant humidity (Zasada et al. 2003).

Longevity: Stored at 1 to 5°C, dried seeds can remain viable for up to 6 months; if stored at subfreezing temperatures (-10 or -20°C) can last up to 36 to 44 months (Zasada et al. 2003).

Propagation

Natural Regeneration: Regenerates by suckering from root system (Zasada et al. 2003) and by seed (Gerling et al. 1996).

Germination: Seeds require light for germination (Anderson 2006).

Fresh seeds will germinate within 12 to 24 hours if kept constantly moist (USDA NRCS n.d.).

Pre-treatment: None required.

Direct Seeding: Direct seeding of fruit was not successful in a trial in northeast Alberta (Smreciu et al. 2008).

Vegetative Propagation: Root and twig cuttings (Tannas 1997). If planted in early spring, hardwood cuttings can root rapidly (USDA NRCS n.d.). Hardwood cutting (18 to 25 cm long and 1.3 to 2.5 cm thick) should be collected and prepared for insertion from November to March; no rooting hormone required; 90% to 100% (Dirr and Heuser 1987).

Cuttings (particularly hardwood) were a successful propagation method on wetland sites in the oil sands reclamation area in Fort McMurray.

Aboriginal/Food Uses

Medicinal: Salicin is a chemical derived from the plant and, chemically, it is related to acetylsalicylic acid (the active ingredient in Aspirin). These chemicals were used by the Native North Americans in preparations to treat toothache, stomach ache, diarrhea, dysentery and dandruff (Anderson 2006). Willow roots were mixed with grease from animal kidneys and used to treat scalp sores and dandruff (Wilkinson 1990).

Other: The bark was used by the Woods Cree to make fishing nets, as an aid in canoe-making and as all-purpose cord. Stems were used to make rims for baskets, bows and arrows, bead weaving looms, and fish roasting sticks. Flexible branches were also used in the construction of backrests and sweat lodges (Tannas 1997).

The inner bark was shredded to make diaper linings and wound dressings. Leaves used to wrap and serve fish (Wilkinson 1990).

Wildlife/Forage Uses

Wildlife: Excellent forage value (Gerling et al. 1996).

Important food source for beaver, moose and elk. Good to fair browsing for mule deer. Dense stands provide cover for wildlife such as waterfowl, small non-game birds, small mammals, white-tailed deer and mule deer (Anderson 2006).

Livestock: One of the less palatable willows (Tannas 1997). High browsing tolerance because of its ability to spread rapidly and form extensive colonies (Tannas 1997).

Fair browse for sheep, fair to poor browse for cattle (Anderson 2006).

Grazing Response: Decreases in response to grazing and heavy utilization may eliminate this species from riparian areas (Hale et al. 2005).

Reclamation Potential

Coyote willow is easily propagated (USDA NRCS n.d.). Once planted, sandbar willow requires little care (Stevens et al. 2003).

Because of its rapid rhizome spreading and dense colony formation (thickets may be several metres in diameter) it can be used as an increaser, declining once trees and shrubs become established (Tannas 1997).

Used to stabilize sand and gravel deposits thus allowing other species to grow (Anderson 2006).

Often found as a natural pioneer on disturbed sites along waterways. In riparian habitats, the dense root system of sandbar willow can serve as an effective shallow groundwater filter and can form overhanging banks which provide habitat for fish and other aquatic living organisms (Stevens et al. 2003).

Resilient to natural disturbances (sediment deposition, flooding, high winds, heavy precipitations, and wildlife browsing) (USDA NRCS n.d.).

Commercial Resources

Availability: This species is prolific and cuttings can often be harvested from natural sites without harm to the parent site. Numerous nurseries and companies in Alberta and Saskatchewan will contract harvest and production of coyote willow.

Cultivars: Greenbank (Northern Great Plains cultivar) (Stevens et al. 2003). Not suitable for reclamation purposes in northeastern Alberta.

Uses: Stabilization of stream bank and lakeshore; development and restoration of riparian habitat and erosion control (Stevens et al. 2003). Flexibility of stems makes it ideal for basket weaving (Hale et al. 2005).

Notes

Well-adapted to fires, will sprout from roots and its numerous wind-dispersed seeds play an important part in the revegetation of burned areas. Because of its typical streamside habitat, which has higher soil moisture content, sandbar willow communities may act as natural fire breaks (Anderson 2006).

Photo Credits

Photos: Wild Rose Consulting, Inc.

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Scientific Name: *Salix lucida* Muhl. **Family:** *Salicaceae*

Common Names: greenleaf willow, Pacific willow, shining willow

Plant Description

Deciduous, perennial, erect, tall shrub or tree 2 to 9 m high; branches light reddish brown or yellowish; glossy branchlets; leaves acute to long-acuminate, glandular-serrulate margins, glossy upper surface, and white-bloomed on lower surface; pubescent petioles with 2 glands near leaf-base; catkins borne on long leafy branchlets, staminate and pistillate catkins occur on separate plant (Moss 1983).

Fruit: Glabrous capsules, 5 to 7 mm long, yellowish (Moss 1983).

Seed: 12 to 20 minute seeds per capsule, 1 to 2 mm long and less than 1 mm wide; attached to the hairs at the radical end; no endosperm (Zasada et al. 2003).

Habitat and Distribution

Lake and slough margins, riparian communities, riverbanks, floodplains, wet meadows, sand-dune slacks, and silt bars (Moss 1983). Low shade tolerance.

Soil: Wet to mesic soil moisture (Tannas 1997). Adapted to most soils but prefers damp heavy soils (Moore 2003).

Pacific willow is an early seral species commonly found on fresh alluvium (Uchytil 1989).

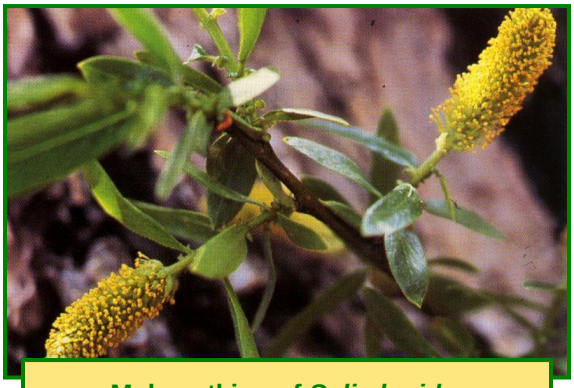
Distribution: Widespread across North America, and throughout Alberta. Alaska, Yukon, southwestern District of Mackenzie, Saskatchewan, Hudson Bay, Newfoundland south to California, New Mexico, South Dakota, Illinois, Ohio, Maryland (Moss 1983).

Phenology

Flowers from April to May, and fruit ripens in June.

Pollination

Salix species are pollinated by insects and by wind (CYSIP: Botany n.d., Macdonald 1986).



Male catkins of *Salix lucida*.

Seed Dispersal

Seeds are attached to pappus for wind dispersal.

Genetics

2n=76 (Moss 1983).

Seed Processing

Collection: Because *Salix sp.* seeds are quickly dispersed by wind, branches may be cut just before seed dispersal and placed in water and kept in shed for easier seed collection. The seeds are then easily stripped from branches (Macdonald 1986).

Seed Weight: 0.0395 g/1,000seeds (Young and Young 1992).

0.173g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Harvest Dates: Harvest as soon as fruits ripen, that is, when catkins change from green to yellow-brown.

Cleaning: For most successful seed extraction, wait until the capsules begin to open (Zasada et al. 2003).

Storage Behaviour: Possibly orthodox; seed should be dried prior to storage at freezing temperatures.

Storage: Once pre-dried to approximately 6% to 10% of dry weight, seeds can be stored in sealed containers in such a way that constant humidity can

be maintained (Zasada et al. 2003). Viability at room temperature declines drastically after a few days (USDA NRCS 2011).
Longevity: Seeds can remain viable for up to 6 months or more if stored at subfreezing temperatures (1 to 5ºC) (Zasada et al. 1983).

Propagation

Natural Regeneration: By tillers and seeds (Gerling et al. 1996).
Germination: Fresh seeds germinate within 12 to 24 hours if kept constantly moist (Moore 2003). The presence of light increases the rate of germination. Significant amounts of chlorophyll are found in the seeds allowing photosynthesis to occur immediately after the seeds are moistened (Uchytil 1989).
Pre-treatment: None, seeds are not dormant. Seeds are sown immediately after collection on moist ground (Dirr and Heuser 1987).
Direct Seeding: Seeding the fruit was not successful in northeastern Alberta (Smreciu et al 2008).
Vegetative Propagation: Zasada et al. (2003) recommend stem cuttings. Take hardwood cuttings from mid-fall to early spring, from 1 to 4 year old wood, 18 to 25 cm long and 1.3 to 2.5 cm thick. Plant cuttings with 25% to 40% of the cutting left above ground (Moore 2003, Rose et al. 1998). Cuttings were a successful propagation method on wetland sites in oil sands land reclamation areas in Fort McMurray: 13% survival of soft tip cutting the 1st year and 15% survival the 2nd year; 36% survival of pole cuttings the 1st year and 35% survival the 2nd year (Smreciu et al. 2008).
Cuttings should be planted to a depth of 30 cm, with 20 cm left above ground. Cuttings will root along the length of the stem, with roots appearing in about 10 days (Uchytil 1989).

Aboriginal/Food Uses

Food: Once dried, the inner bark was ground into a powder and then added to flour to make bread (Marles et al. 2000).
Medicinal: Salicin is a chemical derived from the plant and it is related to acetylsalicylic acid (the active ingredient in Aspirin). These chemicals are used to treat rheumatism, arthritis, aches and pains, and fever (Marles et al. 2000).
Blackfoot people used the willow for fresh root of Salix species to treat internal hemorrhage, throat constrictions, swollen neck glands, and bloodshot or irritated eyes (USDA, NRCS. n.d.).
Other: Stems and bark used for basket weaving. Native Americans used the bark for making fabric and tea and the stems for making bows (Marles et al. 2000). Also used for dye, furniture and mats (USDA NRCS. n.d.).

Wildlife/Forage Usage

Wildlife: Excellent forage value (Gerling et al. 1996). Roots create overhanging banks that provide habitat for fish and other aquatic organisms (USDA NRCS n.d.).
Beaver browse on willow branches. Willow buds and young twigs are eaten by various species of birds (USDA NRCS n.d.). Provides food and cover for many species. Deer, elk, moose and caribou browse on willow twigs, foliage and bark (CYSIP: Botany n.d., Moore 2003, Uchytil 1989).
Livestock: Nutritious plants but low palatability (Tannas 1997).
Grazing Response: Tolerant of heavy browsing (Tannas 1997).

Reclamation Potential

Easily propagated from vegetative cuttings (Stevens 2003).
Recommended for reclamation and stabilization of moist, disturbed soils (Tannas 1997). Regenerates quickly following natural and human-related disturbances (flooding, mine tailings, thermally polluted lands, and construction sites) (Zasada et al. 2003).
High density willow plantings used as a slope stabilizer have been found in some cases to be more

cost effective than using methods like rip rap (Uchytil 1989).
Under any method of revegetation, sites should be fenced to protect them from grazing and trampling . (Uchytil 1989).

Commercial Resources

Availability: Commercially available in Alberta (ANPC 2010).
Cultivars: Roland was released by the Alaska Plant Materials Center for revegetation and landscape projects (Uchytil 1989) in Alaska; not recommended for use in Alberta. Cuttings collected from native populations are preferred.
Uses: Landscaping, used for windbreaks (Moore 2003).

Notes

Following a fire, willows will re-sprout from the root crown or stem base. Because Pacific willow usually occurs along stream banks, it acts as a natural firebreak. Also, it is a prolific seeder thus making off-site plants important seed source for the revegetation of burned areas (Uchytil 1989).
Willow are sensitive to competition and shade so it is recommended that dense grass and weeds are removed from the site (Uchytil 1989).

Photo Credits

Photo 1. William & Wilma Follette. 1992. USDA-NRCS PLANTS Database. http://commons.wikimedia.org/wiki/File:Salix_lucida_lasiandra(02).jpg

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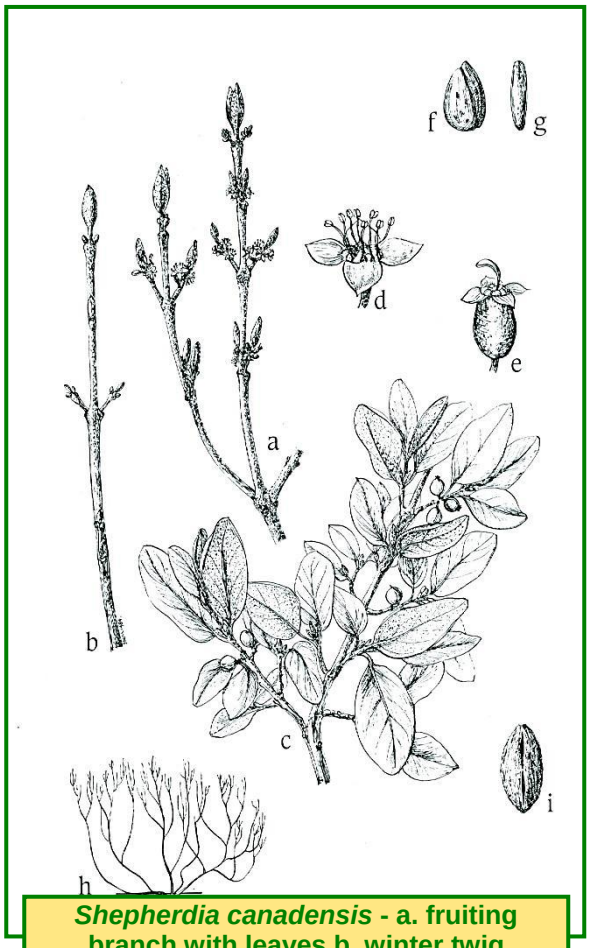
Scientific Name: *Shepherdia canadensis* L. (Nutt.) **Family:** *Elaeagnaceae*

Common Names: buffaloberry, Canadian buffaloberry, soapberry, russet buffaloberry, soopalalie



Shepherdia canadensis **- a. fruiting branch with leaves b. winter twig c. flowering twig d. staminate (male) flower e. pistillate (female) flower f-g. seeds h. growth habit i. pollen.**

Plant Description

Spreading shrub 0.5 to 3 m high, brown branches covered with tiny scales; opposite elliptic to narrowly ovate leaves 2 to 5 cm long reddish-brown hairs; single or small clusters of yellowish brown flowers 4 mm wide, inconspicuous, on stems in leaf axis; male and female flowers are on separate plants (dioecious) (Johnson et al. 1995).

Fruit: Bright red or yellow drupes (spherical to oval) 4 to 6 mm long, may be slightly hairy, juicy and extremely bitter.

Seed: Oval to round, up to 4 mm long, dark brown, somewhat shiny.

Habitat and Distribution

Fairly common in open woods, thickets, coulees, around sloughs and. Moderately tolerant to shade (Hardy BBT 1989).

Seral Stage: Early to late seral species (Gerling et al. 1996).

Soils: Medium to coarse soil texture, wet to mesic soil moisture and possibly somewhat saline tolerant (Gerling et al. 1996). Found on silt loam to sandy loam, well to moderately well drained soils (Inkpen and Van Eyk n.d.); tolerates moderately alkaline to moderately acidic soils (Hardy BBT 1989).

Distribution: Widespread across Alberta. Alaska, Yukon, District of Mackenzie to Hudson Bay, Newfoundland south to Oregon, New Mexico, South Dakota, North Dakota, Minnesota, Ohio, New York (Moss 1983).

Fruit on *Shepherdia canadensis* plants.

Phenology

Flowers May and June prior to leaf flush. Seeds ripen in mid-July to early August.
Fruit ripens June to August. Seeds disperse June to September (Young and Young 1992).
Leaves drop throughout September (Walkup 1991).

Inconspicuous male flowers of *Shepherdia canadensis*.

Pollination

Fly pollinated. Pollination is primarily conducted by Syrphidae and Empididae (Borkent and Harder 2007).

Seed Dispersal

Animal dispersed.

Genetics

2n=22 (Moss 1983).

Symbiosis

Frankia sp. and vesicular-arbuscular mycorrhiza (Visser et al. 1991). *Shepherdia canadensis* forms an association with a different group of *Frankia* species than those that associate with *Alnus sp.* Those strains, which associate with members of the *Elaeagnaceae*, are also more diverse than those that associate with *Alnus sp.* (Huguet et al. 2001).

Seed Processing

Collection: Handpick directly into picking bags or by flailing or stripping from the bush onto a canvas tarp.
Seed Weight: 6.13 g/1,000 seeds. 7.69 g/1,000 seeds (Gerling et al. 1996).
8.42 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Fruit/Seed Volume: 5,640 fruit/L average (5640 seeds/L fruit).
Fruit/Seed Weight: 8,090 fruit/kg average (8,085 seeds/kg fruit).
Average Seeds/Fruit: One seed/fruit.
Harvest Dates: Late July to mid-August when the fruit is bright red or orange in colour (Banerjee et al. 2001).
September 1 to September 30 (Formaniuk 2013).
Cleaning: Macerate fruit in a blender. Suspend residue in water allowing seeds to settle. Decant water and chaff. Repeat suspension and decanting until only seeds remain. Allow seed to dry at room temperature over a moving air stream.
Storage Behaviour: Possibly orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store cool and dry in sealed containers (Luna and Wick 2008).
Longevity: Up to five years (Luna and Wick 2008).

Propagation

Natural Regeneration: By seeds (Gerling et al. 1996).

Germination: McLean (1967) obtained 37% germination (maximum 68% germination) after 120 days following 60 days of cold stratification (1°C). Thilenius et al. (1974) obtained 72% to 80% germination after 20 to 30 minutes sulphuric acid scarification.

Pre-treatment: 30 to 60 days in cold stratification before seeding (Wood pers. comm.).

90 days stratification (Formaniuk 2013).

Hudson and Carlson (1998) recommend five months cold stratification whereas Young and Young (1992) were successful performing acid scarification followed by 60 to 90 days of pre-chilling. McTavish and Shopik (1983) recommend 5 to 15 minute acid treatment followed by 30 day cold stratification.

Visser et al. (1991) suggest acid scarification for 30 minutes. Hudson and Carlson (1998) suggest cleaning seed with 5% to 10% H_2O_2 for 15 minutes; soak seed for 24 hours; stratify for five months in plastic bag with perlite at 2°C; sow April-May first in 100% peat in styro container at 20°C day/15°C night for germination and 15 to 20°C for growing, add 30 to 50 ppm N one to two times/week.

Smreciu and Barron (1997) report that seeds are dormant and require a two winters prior to emergence.

Direct Seeding: When entire frozen fruit were sown in the fall at a northeastern Alberta trial, 3% of seedlings emerged during the third growing season (Smreciu et al. 2012).

Fruit-Sowing Rate: 25 fruit/m².

Vegetative Propagation: Semi-hardwood cuttings (Fung 1984) or root cuttings (Holloway and Zasada 1979).

Inoculations with *Frankia* and/or vesicular-arbuscular mycorrhiza may increase productivity, root nodulation and shoot length (Visser and Danielson 1988, Visser et al. 1991).

Can be successfully grown from containerized seedlings on amended tailings sand (56% to 100%) (Fedkenheuer et al. 1980).

Cuttings taken in July and treated with 8,000 ppm IBA can propagate successfully (Dirr and Heuser 1987).

Greenhouse Timeline: 20 weeks in the greenhouse until out-planting. Plants may be over wintered for Spring or Fall planting (Wood pers. comm.). Grow for 180 days before harvest (Formaniuk 2013).

Seed of *Shepherdia canadensis* each up to 4 mm long.

Aboriginal/Food Uses

Food: Fruit were eaten by many native people, although some considered them to be poisonous. Can be added to buffalo meat for flavouring (Royer and Dickinson 1996, Wilkinson 1990). If large volumes are ingested they can cause diarrhoea, vomiting and abdominal pain. The berries are high in Vitamin C, calcium and iron. The bitter taste improves after the first frost. The berries were often whipped into froth and eaten as a dessert (Droppo 1987, Marles et al. 2000, Royer and Dickinson 1996, Turner 1997, Wilkinson 1990).

Medicinal: Fruit are used to treat constipation, tuberculosis, cuts and sores. Leaves and stems were used to relieve arthritis; shoots were used to prevent miscarriage and treat arthritis and venereal disease;

roots were used for heart medicine; inner bark was used as a laxative; the fresh roots, stems, and twigs were used to relieve infant fever (Gray 2011, Johnson et al. 1995, Turner 1997).
Other: The name soapberry derives from the saponin content in the berry juice (Royer and Dickinson 1996, Wilkinson 1990). Boiled mid-summer branches can be used as a brown hair dye while berries can be used as a shampoo (Gray 2011).

Wildlife/Forage Usage

Wildlife: Fair forage value. Lightly browsed by deer and elk. Black bears, grizzly bears, grouse and snowshoe hares eat the berries (CYSIP: Botany n.d., Favorite and Anderson 2003). Northern Chipmunk harvests the seeds and discards the pulp (CYSIP: Botany n.d.).
Livestock: Low palatability. Poor forage value; fair for sheep only. Used only in the absence of other browse (Walkup 1991).
Grazing Response: Increases with grazing (Tannas 1997).

Reclamation Potential

Tolerant of short term exposure to high salinity water from oil sand tailings (Renault et al. 1998).
Can survive on nutrient poor soils (Favorite and Anderson 2003). Commonly found on disturbed sites throughout Alberta to the subalpine (Hardy BBT 1989).
Buffaloberry often forms dense thickets and is able to fix nitrogen, which in turn contributes to erosion control and soil building.
Visser and Danielson (1988) tested mycorrhizae-inoculated buffaloberry on Syncrude. Overwinter mortality was higher for inoculated buffaloberry but growth of remaining shrubs was three to five times greater over two growing seasons.

Commercial Resources

Availability: Seed is commercially available in Montana from the Native Seed Foundation (Native Seed Network 2009), however this is not recommended for reclamation in Alberta. Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: 'Rubra' and 'Xanthocarpa' are identical to the native species but vary in fruit colour (UMCA 2006) however they are not suitable for reclamation in Alberta.
Uses: Sometimes used as an ornamental.

Notes

Shepherdia canadensis is listed as 89% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Name given by Plains Indians who believed that when the berries were ripe the buffalo were fat enough to hunt (Royer and Dickinson 1996).
Moderately resistant to burning. May increase in vigour and intensity following low to moderate intensity fires by sprouting from surviving root crowns or establishment from seed transported from off-site (Walkup 1991).

Photo Credits

Photo 1: Walter Siegmund, Wikimedia Commons http://upload.wikimedia.org/wikipedia/commons/f/f1/Shepherdia_canadensis_38574.JPG
Photo 2: Bruce Byrne, Philadelphia, Pennsylvania.
Photo 3: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Sibbaldiopsis tridentata* (Ait.) Rydb. **Family:** *Rosaceae*

Common Names: three-toothed cinquefoil, shrubby five fingers

Plant Description

Low shrubby perennial with long creeping rootstocks and tufted leafy shoots, slightly woody at base; flowering stems 10 to 30 cm high; majority of leaves are near the base, firm textured trifoliate leaves, oblong lanceolate, 3 teeth near the apex of each leaflet (Moss 1983).

Fruit: Achenes borne in a head-like cluster (Johnson et al. 1995).

Seed: Brown to black, teardrop shaped to 1 mm long.

Habitat and Distribution

Prefers dry sandy areas and open pine forests (Budd and Best 1969).

Seral Stage: Early to mid-seral.

Soil: Gravelly, sterile, acidic (pH<6.8) soils (Ladybird Johnson Wildflower Center 2009).

Distribution: Southwestern District of Mackenzie to Hudson Bay, northern Quebec, Newfoundland south to Alberta, Saskatchewan, North Dakota, Iowa, Minnesota, Michigan, New York, Appalachia (Moss 1983).

***Sibbaldiopsis tridentata* flower**

***S. tridentata* growing in a rock crevice.**

Phenology

Plants bloom from June to August. Seeds mature in a type of pod which turns from green to grayish-brown during the 3 to 4 week period after blooming (Ladybird Johnson Wildflower Center 2009).

Pollination

Possibly by insects (Hilty 2012).

Seed Dispersal

Unknown, but likely by passing animals, breaking papery receptacle.

Genetics

2n=14, 28 (Moss 1983).

Symbiosis

None known.

Seed Processing

Collection: Collect entire fruiting stalks; air-dry before cleaning.

Seed Weight: 0.39 g/1,000 seeds.

Harvest Dates: Middle to late August.
Cleaning: No cleaning required (Schultz et al. 2002). If entire stalks harvested, shake seeds from receptacles after drying. Screens can be used to separate seeds from husks.
Storage Behaviour: No literature found.
Storage: Refrigerate in airtight containers (Ladybird Johnson Wildflower Center 2009).
Longevity: Seed maintains viability after one year of cool dry storage.

Seeds of *S. tridentata.* Seeds are approximately 1 mm long.

Propagation

Natural Regeneration: *S. tridentata* is clonal and spreads well on early seral sites (Marchand and Roach 1980).
Germination: 60% germination following 4 week cold stratification.
Optimal germination temperature 21˚C to 26˚C: taking on average 21 days to germinate (Marchand and Roach 1980).
Pre-treatment: Cold-moist stratify for 6 weeks (Ladybird Johnson Wildflower Center 2009).
Direct Seeding: Fresh seed sown outdoors after harvest will germinate the next spring. Seedlings do not flower for two years (Ladybird Johnson Wildflower Center 2011).
Vegetative Propagation: Vegetative propagation is *S. tridentata*'s main reproduction method (Marchand and Roach 1980). Plants can reproduce vegetatively by producing new plants from underground runners and are best divided in the fall (Hilty 2012).

Aboriginal/Food Uses

No literature found.

Reclamation Potential

S. tridentata was shown to be resistant to compaction and can grow in low nutrient conditions. In a case study done by Olfelt et al. (2009), *S. tridentata* successfully revegetated cliff edges disturbed by recreational activities.
Has been used in green roof landscaping study with 99% survival after one growing season (Wolf and Lundholm 2008).

Commercial Resources

Availability: Is available commercially in Alberta (ANPC 2010).
Cultivars: None.

Notes

Synonym *Potentilla tridentata* (Budd and Best 1969, Schultz et al. 2002).
Sibbaldiopsis tridentata is listed as 96% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photos 1 and 2: Walter Muma @ Ontariowildflowers.com
Photo 3: Wild Rose Consulting, Inc.

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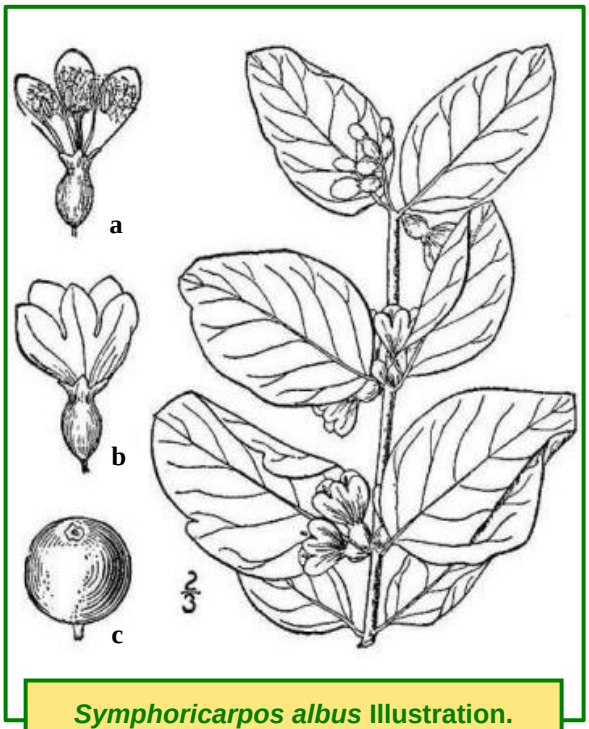
Scientific Name: *Symphoricarpos albus* (L.) Blake

Family: *Caprifoliaceae*

Common Names: snowberry, common snowberry, white coralberry



***Symphoricarpos albus* Illustration. A. stamens and corolla b. flower c. fruit**

Plant Description

Deciduous, perennial, erect, slender shrub, up to 1 m high, rhizomatous; leaves opposite oval to ovate thin wavy leaves 2 to 4 cm long; clusters of bell-shaped flowers at branch tips, pink and white, hairy within, 4 to 7 mm long (Johnson et al. 1995).

Fruit: Dry, waxy berry, white, spherical, 6 to 12 mm, not edible, two seeds per berry (Johnson et al. 1995).

Seed: Ivory seeds, 2 to 3 mm x 3 to 4 mm flat on one side/round on other, rough.

Habitat and Distribution

Common in bushy areas, open woodland and valley slopes (Moss 1983).

Soil: Found on rocky and coarse textured soils. *S. albus* is tolerant of mildly acidic-moderately alkaline soils and a moderate tolerance of salinity (Hardy BBT 1989, USDA NRCS n.d.). Adapted to wet and dry soil conditions (Tannas 1997).

Distribution: Widespread across Alberta: parkland, prairie, foothills and across southern boreal forest. Southeastern Alaska, southern District of Mackenzie, British Columbia to Quebec, Nova Scotia south to California, Idaho, Colorado, Nebraska, Virginia (Moss 1983).

Phenology

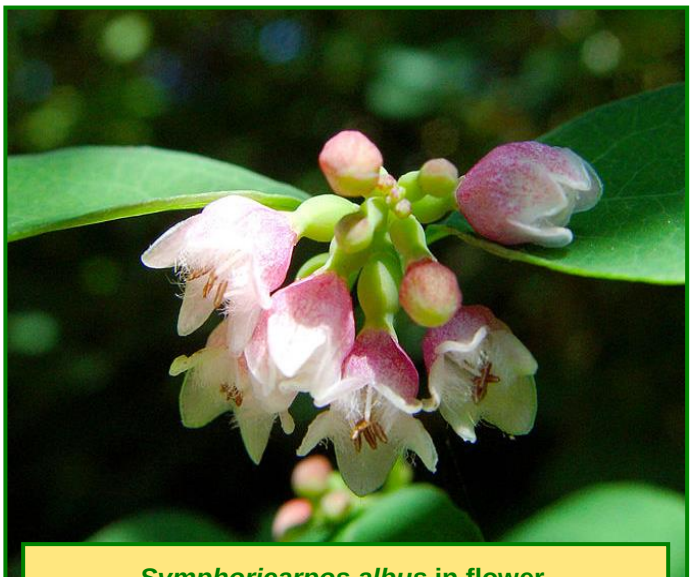
Flowers June to August. Fruits ripen in late July through September.

Pollination

Pollinated by insects and occasionally hummingbirds.

Seed Dispersal

Animal dispersal.



***Symphoricarpos albus* in flower.**

Genetics

2n=36, 54, 72 (Moss 1983).

Symbiosis

Associated with vesicular-arbuscular mycorrhizae in British Columbia (Berch et al. 1988).

Seed Processing

Collection: Berries are often found singly or in pairs and are sparse on shrubs making collection more difficult. Handpick or hand-strip fruits directly into picking bags or groundsheets (Banerjee et al. 2001).
Seed Weight: 4.81 to 5.71 g/1,000 seeds (5.26 average).
Fruit/Seed Volume: 3,020 to 3,460 fruit/L (3,220 average), 6,400 seeds/L fruit.
Fruit/Seed Weight: 9,000 to 11,200 fruit/kg (10,000 average), 20,000 seeds/kg fruit.
Average Seeds/Fruit: 2 seeds/fruit.
Harvest Dates: Ripe fruits are waxy white in colour (Banerjee et al. 2001).
Collect in late August.
Cleaning: Mash fruit in a sieve (1.40 mm works well). A blender with taped blades may also be used to macerate the fruit. Suspend residue in water allowing seeds to settle. Decant water and chaff. Repeat suspension and decanting until only seeds remain.
Alternatively, a tomato de-seeder may be used.
Allow seeds to dry at room temperature over a moving air stream.
Storage Behaviour: Possibly orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store dry in sealed containers at low temperatures (Young and Young 1992).
Longevity: If kept in sealed containers at low temperature (5°C), dried seeds can be stored for at least 2 years (Rose et al. 1998, Young and Young 1992). McWilliams (2000) had success storing seeds up to 7 to 10 years.

Propagation

Natural Regeneration: By seeds and from suckers (Hardy BBT 1989).
Germination: Field emergence is more successful than *in vitro* germination (Piper 1986).
Seeds are dormant and require a double cold period to initiate germination (Smreciu and Barron 1997).
Pre-treatment: Young and Young (1992) recommend 3 months warm stratification followed by 4 months cold stratification.
Direct Seeding: 4% emergence by year 4 on oil sands reclamation sites in northeastern Alberta (Smreciu et al. 2012). Smreciu and Barron (1997) report an abundance of seedlings emerging after 2 winter seasons.
Fruit Sowing: From 0.41% emergence after 2 years (fall sown) to 8% emergence after 4 years (spring sown) by sowing fruits. Spring sown (frozen) fruits tend to emerge better than fall sown ones.
Seeding Rate: 50 seeds/m², 12 fruits/m² to obtain 1 to 2 plants/m².
Vegetative Propagation: From suckers (Hardy BBT 1989) and by layering (Babb 1959).
Softwood cuttings have been successful with *S. occidentalis* as well as *S. albus* (Smreciu and Barron 1997). Softwoods and semi-hardwood cuttings produce 90% to 100% rooting from June-August with IBA-talc or solutions of 1,000 to 3,000 ppm. Hardwood cuttings root 90% to 100% in 4 to 6 weeks from December-January with 3,000 ppm IBA-talc (Dirr and Heuser 1987). Collect 15 to 20 cm long hardwood cuttings from June to August and stick in soil in shaded area. Store cuttings over winter in damp sawdust or peat moss. In late February to early March, dip in an IBA talc or solution 1,000 to 3,000 ppm and stick in potting soil (Rose et al. 1998).
Containerized seedlings were successful on amended tailings sand (75% to 92%) (Fedkenheuer et al. 1980).

Aboriginal/Food Uses

Food: Inedible, considered poisonous by many native people.

Medicinal: Fruits can be crushed or boiled to make a wash for sore eyes. Fruit is a strong laxative (Royer and Dickinson 1996). Root and stem decoction used to treat teething pain in children; the wash can be used to treat skin rashes, or can be mixed with other plants to make a tea for venereal disease. Boiled leaves and branches make a diuretic decoction and can treat kidney problems and can be part of a compound aphrodisiac (Marles et al. 2000).
Other: Blackfoot used the plant as a broom (Royer and Dickinson 1996).

***Symphoricarpos albus* seeds**

Wildlife/Forage Uses

Wildlife: Valuable source of browse for elk, bighorn sheep, white-tailed deer, moose, grizzly bears. Important cover and food source for birds (sharp-tailed, ruffed and blue grouse, wild turkey, kingbird, western flycatcher and western bluebird), and small mammals (fox squirrels, desert cottontails, and pocket gophers) (McWilliams 2000).

Livestock: Important to domestic sheep and cattle (McWilliams 2000). Re-sprouts after grazing (Hardy BBT 1989).

Reclamation Potential

Tolerant of low nutrient sites (Hardy BBT 1989). Extensively used in rehabilitation of disturbed locations. Very good first year survival (75%) on amended tailings sand in northern Alberta (Hardy BBT 1989). Previously used for reclamation of tailings sands (Fedkenheuer et al. 1980) and on mining sites with acidic, steep tailings (Voeller et al. 1998).
In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that *S. albus* did not invade any of the plots.
Once established, has a good survival rate. Excellent for bank stabilization and erosion control. Also has a high resistance to fire (McWilliams 2012).

Commercial Resources

Availability: Seedlings are available from local Alberta nurseries.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivar: None are known.

Notes

Symphoricarpos albus is listed as 80% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
After being fed to cattle and digested, the seeds do not undergo scarification or hastened germination; the seeds remain viable for an extended period of time (Doucette et al. 2001).

Photo Credits

Photo 1: http://commons.wikimedia.org/wiki/Image:Symphoricarpos_albus.jpg
Photo 2: WRC, Inc. 2013.

Line drawing: Britton, N.L. and A. Brown, 1913. An illustrated flora of the northern United States Canada and the British Possessions. Vol. 3, p. 276.

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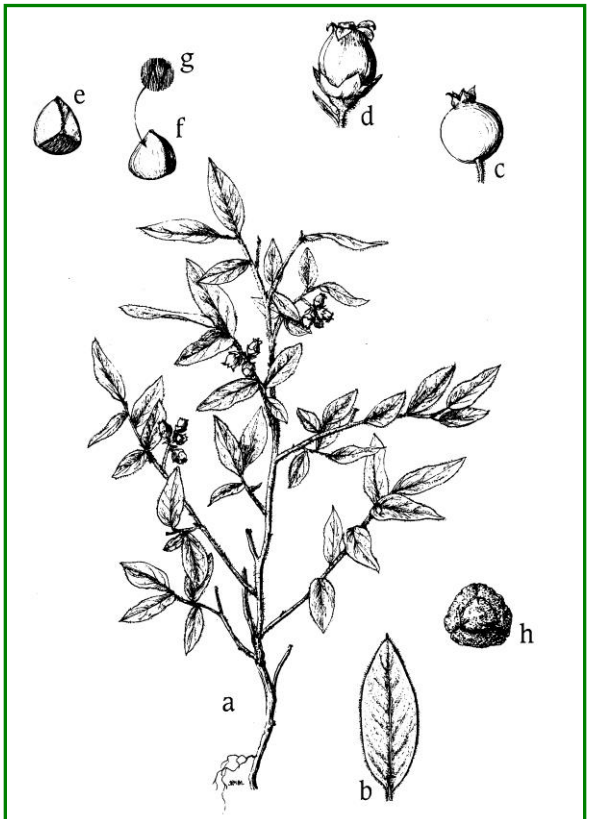
Scientific Name: *Vaccinium myrtilloides* Michx. **Family:** *Ericaceae*

Common Names: blueberry, velvet-leaf blueberry, Canada blueberry, velvet-leaf huckleberry



***Vaccinium myrtilloides* - a. branch with inflorescence and leaves, b. leaf, c. fruit, d. flower, e-f. seed, g. seed surface, h. pollen.**

Plant Description

Low evergreen shrub, perennial, 10 to 50 cm high; pubescent twigs; leaves entire alternate thin velvet elliptic, 1 to 4 cm long; small and short clusters at branch tips of greenish white to pink flowers, cylindrical bells 3 to 5 mm long.

Radical develops into taproot finely divided at extremities devoid of root hairs (Vander Kloet and Hall 1981), long tapering structure typical of a root (as deep as 1 m) and rhizomes have a stem-like structure (Hall 1957). Rhizomes 3 to 11 cm deep (Flinn and Wein 1977, Smith 1962). Branching, deeper roots were found by Smith (1962) but no taproots.

Fruit: Blue with whitish bloom, 4 to 8 mm wide, spherical, edible berry, and approximately 37 seeds per berry.

Seed: 1 mm ovoid to obconical, umber brown, rugose seeds.

Habitat and Distribution

Lowbush blueberry is common on acidic soil (pH from 3.0 to 5.9) in peat bogs, muskegs, peatlands, alpine and mountain meadows, sandy soils in open forests and clearings. Grows well on dry acidic soils of coniferous woods and on open or thinly wooded hillsides throughout Alberta, especially in sandy areas (Inkpen and Van Eyk n.d.)

Relatively intolerant to shade (Rogers 1974).

Soil: Optimum pH range of 4.0 to 5.5. Requires acidic soils, grows well on sandy loam soils (Carter and St-Pierre 1996). Most productive in light, well drained acidic soils high in organic matter. Common on stony, silt, and clay loam soils (Rogers 1974).

Seral Stage: Early secondary successional. Highest abundance in young post-disturbance communities (Tirmenstein 1990).

***Vaccinium myrtilloides* in flower.**

Distribution: Common in the boreal forest. Southern District of Mackenzie to southern Hudson Bay, Newfoundland south to western Montana, Alberta, southern Saskatchewan, southern Manitoba, Iowa, Great Lakes and Virginia (Moss 1983).

***Vaccinium myrtilloides* plant in fruit.**

Phenology

Flowers in April through July (Banerjee et al. 2001). Fruit ripens in July through August (Dirr and Hauser 1987).

Pollination

Andrenids, some *Bombus sp.* (Reader 1977, Vander Kloet 1981), and *Apis mellifera* L. (Whidden 1996). *Andrenids* and *Apis* are the most common, however *Bombus* is the most effective (Whidden 1996).

Seed Dispersal

Animal dispersal.

Genetics

2n=24 (Moss 1983).

Symbiosis

Blueberry associates with the ericoid mycorrhiza fungi and a diverse assemblage of fungal endophytes (e.g., *Hymenoscyphus ericae*) (Hambleton et al. 1999, Massicotte et al. 2005) that increase effectiveness of nitrogen uptake in high acidic soils (Jansa and Vosátka 2000). Young plants/seedlings are less likely to form mycorrhizal associations (McKechnie 2009).

Seed Processing

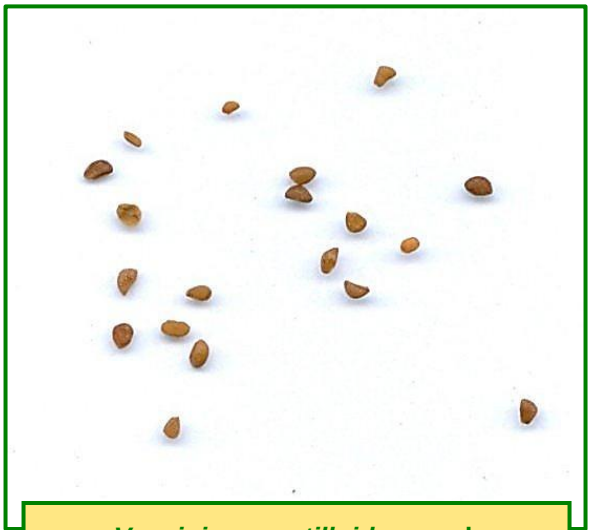
Harvest Dates: Late July, when the fruit is bluish black and bloomy.

Collection: Although time consuming, berries borne in clumps on these low shrubs are not difficult to collect. Handpick or hand-strip directly into buckets, picking bags or onto ground sheets.

Seed Weight: 0.060 to 0.214 g/1,000 seeds (0.147 average).

0.2 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Fruit Volume: 1,870 to 3,380 fruit/L (2,540 average), 93,800 seeds/L fruit.



***Vaccinium myrtilloides* seed.**

Fruit Weight: 3,740 to 7,070fruit/kg (5,240 average), 194,000 seeds/kg fruit.
Average Seeds/Fruit: 37 seeds/fruit.
Cleaning: Macerate in blender for 20 to 30 seconds on stir with equal amount of water, decant water and chaff. Repeat suspension and decanting until only seeds remain. Allow seeds to dry at room temperature over a moving air stream.
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: Store at cool temperatures (Young and Young 1992).
Store with moisture contents equivalent to 15% RH or lower (Royal Botanic Gardens Kew 2008).
Longevity: Seeds up to 5 years old have been found to be viable (Granström 1987).

Propagation

Natural Regeneration: Both by seed and vegetatively (Tirmenstein 1990). Vegetative spread is mainly via laterally branched woody rhizomes that can establish dense mats (Carter and St-Pierre1996). Reproduces from sprouts and suckers (Rogers 1974).
Germination: 10% germination in 90 days with fresh, 1 to 2 year old seeds.
Most successful in 1:1 sand-peat mixtures at a pH of 4.5 (Tirmenstein 1990).
Bimodal germination at 18 and ~80 days up to 30% (Vander Kloet 1994).
Young and Young (1992) report that light can increase the success of seed germination.
Dormancy may be induced by drying seed, but it is broken with cold storage (McKechnie 2009).
Germination is more favourable under warm conditions (15/25°C diurnal) in the presence of light (McKechnie 2009).
Pre-treatment: Often not required as many seeds are mostly non-dormant. However 1 to 2 months of stratification is used by Smoky Lake Forest Nursery (Darago pers. comm.).
Direct Seeding: No significant emergence observed by sowing seeds, only small seedlings were observed in later years on oil sands reclamation sites in northeastern Alberta. Emerged from fruit; fall sowing did slightly better than spring sowing when frozen seeds were used. Direct fruit sowing produced slightly greater emergence than direct seed sowing (Smreciu, et al. 2008).
Seedling Development: Radicals 20 days after seeding, cotyledons 31 days, first true leaves 48 days (Vander Kloet 1981) and can be transplanted 6 to 7 weeks after emergence (Rook 2002).
Vegetative Propagation: Can be propagated from 10 to 13 cm long hardwood cuttings (Rook 2002), however McKechnie (2009) does not recommend this method. Harvest rhizome cuttings in early spring or late summer and autumn (Dirr and Hauser 1987). Gibberellic acid and IBA can decrease rooting of rhizome cuttings and should be avoided; bottom heat has no effect (McKechnie 2009). Generally propagated from softwood cuttings 7 to 8 cm in length (Carter and St-Pierre 1996). Babb (1959) suggests using division.
Micro-propagation: Nickerson (1978) reports successful propagation through cultured seedling explants (excision and culture of cotyledons and hypocotyls).
Greenhouse Timeline: 60 days cold stratification before sowing.
26 weeks in the greenhouse prior to out-planting. Dormant seedlings can be stored frozen over winter for spring or early fall planting (Wood pers. comm.).

Aboriginal/Food Uses

Food: *V. myrtilloides* is one of the most important fruits for local native people. Eaten fresh, cooked with sugar or lard, canned, or sun dried. Dried fruit can be mixed to pemmican. Beverages can be made by boiling the dried leaves (Marles et al. 2000).
Medicinal: Eating the fruits relieves acne; blueberry syrup can treat vomiting and diseases of the lung (Wilkinson 1990) and stems can be boiled to make a tea to prevent pregnancy. When combined with other plants, can prevent miscarriage, increase bleeding after childbirth, regulate menstruation, and stimulate sweating. The whole plant can be used as medicine to treat cancer. A decoction made from boiling the roots can be taken to relieve headaches (Marles et al.

2000). A diuretic tea can be made from the berries and is said to be a blood tonic (Royer and Dickinson 1996).
Other: Berries used to dye porcupine quills (Royer and Dickinson 1996).

Wildlife/Forage Uses

Wildlife: Berries are an extremely important food source for black bear and grizzly bear. White-tailed deer and eastern cottontail browse the leaves and twigs. Many mammals feed on the berries (white-tailed deer, red fox, porcupine, raccoon, mice, chipmunks, pika, white-footed mouse, grey fox, ground squirrel, deer mice, and skunks). Many birds, such as wild turkey, grey catbird, band-tailed pigeon, ring-necked pheasant, and quails, ptarmigans, towhees, spruce, ruffed, blue, and sharp-tailed grouse, American robin, American crow, bluebirds, and various other small birds, also feed on the fruit (Tirmenstein 1990).
Livestock: Browse is of relatively low palatability to most domestic livestock (Tannas 1997).

Reclamation Potential

Valuable ground cover species in areas of low vegetation cover (Tannas 1997).
Requires minimum site preparation.
Popular edible berry for both humans and animals.
Carter and St-Pierre (1996) report that blueberries are excellent colonizers of disturbed areas.
Haeussler et al. (1999) found that they are sensitive to high severity disturbances (natural and mechanical) and exhibit a slow recovery. However, moderate disturbances such as partial cutting can significantly improve berry production. This is possibly due to increased light availability and its vegetative habit. Although slow to recover after soil disturbances, moderate disturbance (fire or surficial damage) can encourage regrowth (McKechnie 2009).
For *V. myrtilloides* to expand and dominate an understory area, the faster growing hardwood species, which are aggressive competitors and invaders, must be suppressed and controlled (Moola and Mallik 1998). Moderate shade however is necessary because it aids in moisture conservation and foliage sunburn prevention (Smith 1962).
V. myrtilloides is relatively tolerant of drought (McKechnie 2009).

Commercial Resources

Harvest Methods: Handpicking, rakes and mechanical harvesters are all harvesting options. Mechanical harvesters range from over-the-row to hand-held vibrators with catch frames. Some berry loss is inevitable with this method.
Availability: Although commercially available, local stock may be difficult to purchase.
Cultivars: Many different clones (over 1,000) are available from Nova Scotia (Carter and St-Pierre 1996) but are not suitable for reclamation purposes.
Uses: Fresh fruit, jams, syrups. Potential for value-added food and beverage products (Marles et al. 2000).

Notes

Vaccinium myrtilloides is listed as 97% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Compared to other fruit crop species, *V. myrtilloides* has low nutrient requirements (Carter and St-Pierre 1996).
Because of their deep subterranean reproductive plant parts (4 cm below the mineral soil), blueberries have a high survival rate during fire (Flynn and Wein 1977).
Studies have shown that to maximize yield, significant stands of *V. myrtilloides* should be burnt every third year (Vander Kloet 1994).

Photo Credits

Photo 1, 3: Wild Rose Consulting, Inc.
Photo 2: Glen Lee, Regina, Saskatchewan.
Line Diagram: John Maywood, used with permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Vaccinium oxycoccos* **Family:** Ericaceae

Common Names: small bog cranberry

Plant Description

Tiny vine-like, evergreen shrub; stem thread-like, slender, 10 to 50 cm long, creeping and rooting; leaves widely spaced, leathery elliptic to egg-shaped, 2 to 6 mm long, 1.5 to 2 mm wide, sharp-pointed, dark green above, grey-waxy below with edges rolled under; flowers deep pink and drooping, 1 to 3 on slender hairless stalks, 4 petals sharply bent backwards (Moss 1983).
Fruit: Pale pink to dark red, occasionally spotted, 5 to10 mm.
Seed: Minute brown seed.

Vaccinium oxycoccos in flower

Habitat and Distribution

Grows on poorly drained subhygric to hygric peat sites. Most often found in Sphagnum moss bog. Shade intolerant (Matthews 1992).
Seral Stage: Generally mid-seral in primary succession, it is also an early colonizer in secondary successions (i.e., burned bogs) (Matthews 1992).
Soil: Rich organic soils, poorly drained. Prefers very acidic soils (Mathews 1992).
Distribution: Alaska, Yukon, western District of Mackenzie to Hudson Bay, southern Labrador south to British Columbia, Alberta, central Saskatchewan, southern Manitoba, James Bay (Moss 1983).

Phenology

Flowers appear from late May and can last into July.

Pollination

Self-pollinating but insect cross pollination increases fruit set (Froborg 1996).

Seed Dispersal

Animal dispersed (Matthews 1992).

Genetics

2n=24 (Moss 1983).

Symbiosis

Associated with *Hymenoscyphus ericae* (Jacquemart 1997).

Seed Processing

Collection: Harvest by hand in late August and September. Berries are widespread between stems and very time consuming to collect.
Seed Weight: 0.6 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
0.982 g/1,000 seeds (Jacquemart 1997).
Average Seed/Fruit: 8 seeds (Vander Kloet and Hill 1994).
Harvest Dates: Late August up until snowfall.
Cleaning: Macerate fruit in a blender, decant chaff to retain clean seed.
Storage: Orthodox. Store dry at very low (freezing) temperatures (Royal Botanic Gardens Kew 2008).

Longevity: One-year-old seed exhibited 78% germination (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: Spread by seed but primarily vegetative by rhizomes or layering (Rook 2002).
Germination: Sped up by after ripening of seeds for 6 to 7 months (Matthews 1992).
Pre-treatment: Cold stratify seeds for thirty days prior to germination (Jacquemart 1997).
Direct Seeding: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: Reproduces by rhizome, but resistant to transplantations (Matthews 1992).
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: High pectin content makes small bog cranberry ideal for making jams and jellies. Fresh fruit is best after a frost, but may also be eaten cooked (Marles et al. 2000).
Medicinal: Berries twigs and bark used for various purposes (Mathews 1992).

Wildlife/Forage Usage

Wildlife: Small mammals and some birds feed on the berries (Matthews 1992), specifically, foxes, bears, songbirds and grouse (Jacquemart 1997).
Vaccinium oxycoccos is a larval host and/or nectar source for the Bog Fritillary (*Boloria eunomia*)(Lady Bird Johnson Wildflower Center 2007).
Livestock: Not used for livestock forage. Sometimes called *fool-hen berries* because grouse like to eat them (Turner 1997).

Reclamation Potential

Grows well in acidic peat substrates and has been established on disturbed saline bog (Mathews 1992).

Commercial Resources

Availability: Limited commercial availability. Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: No literature found.

Uses: Berries used in cooking.

Notes

Synonyms *Oxycoccus microcarpus*, *Vaccinium microcarpus* (Turcz. ex Rupr.) Schmalh (ITIS n.d., Lady Bird Johnson Wildflower Center 2007, Moss 1983).
Vaccinium oxycoccus is listed as 94% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Wild Rose Consulting, Inc.

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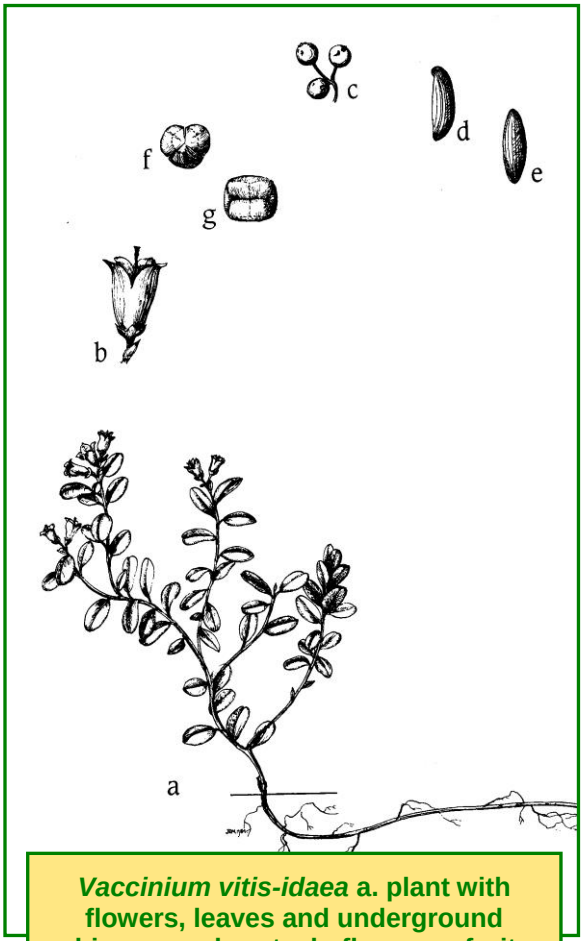
Scientific Name: *Vaccinium vitis-idaea* L. **Family:** *Ericaceae*

Common Names: bog cranberry, cowberry, lingonberry, mountain cranberry, partridgeberry, northern mountain cranberry, lowbush cranberry



***Vaccinium vitis-idaea* a. plant with flowers, leaves and underground rhizome and roots, b. flower, c. fruit, d-e. seeds, f–g. pollen.**

Plant Description

Perennial, semi-erect or creeping dwarf shrub, 5 to 20 cm high; forms large clones; fine hair-like roots from rhizomes with maximum rooting depths of 5 to 28 cm (Tirmenstein 1991), occasionally a taproot; stem creeping or trailing; leaves evergreen, alternate, entire (not toothed), shiny above, pale with black glandular dots beneath, thick, rolled edges (under), 6 to 15 mm long, leaves turn purple to red in the fall; inflorescence a short terminal cluster of 5 to 15 flowers; flower rose to white, cup shaped, 5 mm diameter (Moss 1983). Rhizomes may be more than 20 years old (Gustavsson 2000).

Fruit: Carmine, spherical berry, 5 to 10 mm diameter; edible, acidic (Moss 1983).

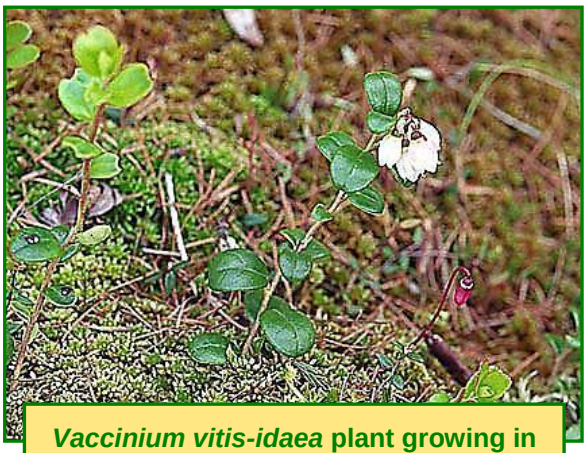
Seed: 1 mm long, egg-shaped, brown to yellow, smooth to rough texture with a short beak.

Habitat and Distribution

Habitat: Northern temperate forests; dry, open woods particularly as a subdominant under *Pinus* spp. and *Betula papyrifera*, open spruce (*Picea* spp.) and aspen (*Populus tremuloides*) woods; dry bogs with *Sphagnum* moss, *Picea mariana* and *Larix laricina* as well as alpine slopes. Can tolerate shade but blooms more abundantly in more open areas. Drought-resistant (Tirmenstein 1991).

Seral Stage: Not generally a pioneer species but can be an early invader in some communities.

Soils: Dry, poorly developed, mineral soils or well-drained peat bogs; best on pH 4.0 to 4.9 (Tirmenstein 1991).



***Vaccinium vitis-idaea* plant growing in moss.**

***Vaccinium vitis-idaea* flowers.**

Distribution: Very common and widespread across boreal forest, aspen parkland, and montane regions of Alberta. Circumpolar and circumboreal. Alaska, Yukon, Victoria Island to southern Baffin Island to Newfoundland, south to British Columbia, Alberta, central Saskatchewan, southern Manitoba, Minnesota, southern James Bay, southern Quebec (Moss 1983).

Phenology

Vegetative growth resumes in late May to early June; flowers in late June and July (early August), fruit ripens in late August and September; leaves often turn reddish-purple in fall as dormancy commences; rhizomes grow actively in spring and fall.

Pollination

Pollinated by bumblebees or syrphid flies, and butterflies (Rook 2002).

Although self-pollinated individuals have reduced fruit set, the reduction is not significant. *Vaccinium vitis-idaea* is not reliant on pollinators (Froborg 1996).

Seed Dispersal

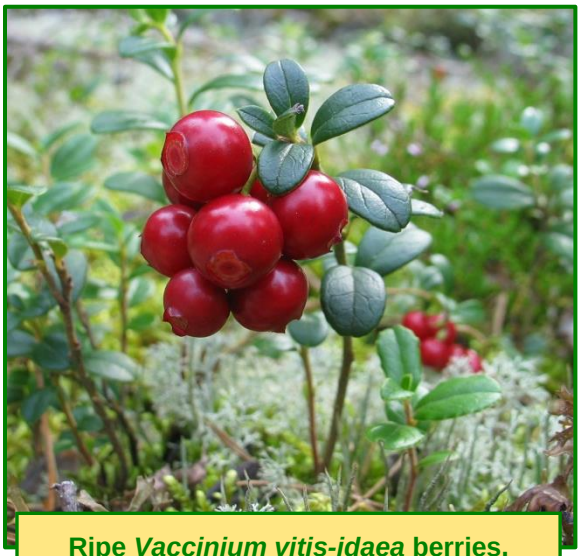
Animal dispersal.

Genetics

2n=24 (Moss 1983).

Symbiosis

Forms ericoid mycorrhizae with a diverse assemblage of fungal endophytes (e.g., *Hymenoscyphus ericae*) (Hambleton et al. 1999, Massicotte et al. 2005). *V. vitis-idaea* is host of the root endophytic fungus *Phialocephala fortinii* (Addy et al. 2000).



Ripe *Vaccinium vitis-idaea* berries.

Seed Processing

Harvest Dates: Late August early September.
Collection: Low growing plants make collection difficult; hand collection is time consuming.
Seed Weight: 0.21 g/1,000 seeds.
Royal Botanic Gardens Kew (2008) measure the weight at 0.3 g/1000 seeds.
Fruit/Seed Volume: 1,850 to 4,780 fruit/L (3,190 average), 38,200 seeds/L fruit.

Fruit/Seed Weight: 380 to 10,200 fruit/kg (7,050 average), 84,600 seeds/kg fruit.
Average Seeds/Fruit: 12 seeds/fruit.
Cleaning: Place pulpy fruits in a blender (use about 3:1 water with fruit) on low speed until fruits are fully macerated (20 to 30 seconds). Pour through sieve(s) to remove chaff smaller than seeds. Re-suspend residue in water and mix; allow seeds to settle and decant water with floating and suspended larger chaff. Repeat re-suspension step until seeds are clean; sieve if necessary and place seeds on paper toweling or cloths to dry. Dry at room temperature or up to 25°C over a moving air stream.
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: Store dry at ambient room temperatures; fruit can be frozen soon after collection and seeds removed up to several years later. Dry to 15% relative humidity and freeze at -20°C (Royal Botanic Gardens Kew 2008).
Longevity: 5 year old seeds can remain viable (Granström 1987).

***Vaccinium vitis-idaea* Seed.**

Propagation

Natural Regeneration: Spreads by rhizomes and can form dense patches (St-Pierre 1996).
Germination: >85% germination after 60 to 90 days stratification with fresh or one year old seeds. Baskin et al. (2000) found that germination increased significantly in the presence of light after 12 to 20 weeks of stratification.
Holloway (1981) found the best substrate for seed germination is milled peat or an equal mixture of peat and sand.
Pre-treatment: Stratification of 60 to 90 days for fresh or older seeds; seed lots extracted from fruit frozen for several years germinated reasonably well after a 28 day stratification. No stratification is necessary if seeds are exposed to 250 mg/L GA3 (Royal Botanic Gardens Kew 2008).
Direct Seeding: No significant emergence observed, only small seedlings observed in later years (Smreciu, et al 2008).
Fruit Sowing: Produced small seedlings (0.58% 4 years after fall sowing). Direct fruit sowing produced slightly greater emergence than direct seed sowing.
Vegetative Propagation: Plants enlarge by means of horizontal rhizomes and by nodal rooting of above-ground branches; daughter plants can be separated from parent plants.
Semi-hardwood cuttings collected in early May root well when treated with Stim-root #3 (Dirr and Heuser 1987, Smreciu and Gould 2003). Babb (1959) suggests division. Terminal stem cuttings (4 to 5 cm) were harvested regularly every month in more than one year and rooted in peat mixed with 30% perlite without auxin treatment (Martinussen et al. 2006). Cuttings harvested during spring and summer rooted poorly compared to cuttings harvested in late autumn and during winter (Martinussen et al. 2006). The best rooting was obtained using cuttings harvested in September and November (Martinussen et al. 2006). Gustavsson (2000) found variable results for harvest time but suggested that July and August would produce good results.

Gustavsson (2000) found the best rooting occurred in outdoor plastic tunnels with bottom heat compared to a heated greenhouse.
A relatively short cold period is needed to induce bud break and shoot growth (Martinussen et al. 2006).
Planting Density: 130 to 517 plants per hectare (USDA NRCS n.d.).
Micro-propagation: Leaf explants placed with the adaxial side in contact with zeatin (a medium with 5 to 30 µM ZN) with a seven day dark treatment were the best conditions for organogenesis (Debnath and McRae 2002).
Nodal segments supplemented with 9.1 µM zeatin and 5.7 µM IAA, 72% of explants developed multiple shoots (Meiners et al. 2007).
Planted directly, *in vitro* shoots root better than field cuttings (Meiners et al. 2007).
Greenhouse Timeline: 30 to 60 days of cold stratification prior to sowing.
26 weeks in the greenhouse prior to outplanting.
Dormant seedlings can be stored frozen over winter for spring or early fall planting (Wood pers. comm.).

Aboriginal/Food Uses

Food: Primarily berries are used for food; berries eaten fresh or made into sauce and jelly and used in pemmican. Sweetest after a few frosts – stay ripe and juicy into the next spring (CYSIP: Botany n.d.). Rich in vitamin C (Royer and Dickinson 1996) and pectin (Gray 2011).
Medicinal: Ho et al. (2001) isolated the active components of *Vaccinium vitis-idaea* and found that it may be used as an alternative treatment of periodontal disease. The active ingredients were identified as: arbutin, hyperin, hydroquinone, isoquarcetin and tannins. Contains high levels of flavonoids that can help lower blood-sugar and reduce symptoms of allergies (Gray 2011). Used raw to relieve fevers, sore throats and upset stomachs. Berries were used in hot packs to treat swellings, aches, pains, and headaches. Drinking a juice from the berries is said to cleanse the urinary tract (Gray 2011 – active ingredient is arbutin, Royer and Dickinson 1996).

Wildlife/Forage Usage

Wildlife: Browsed by black bear, moose, caribou and snowshoe hare; berries are an important source of food for black bears in fall and spring, for grouse and for migrating birds in spring and for numerous other birds; berries also eaten by red-backed voles and red fox in fall; numerous small mammals burrow under snow to obtain fruits that persist on plant (Tirmenstein 1991).
Livestock: Plants are of little value to livestock; eaten by domestic sheep if more preferable species are unavailable (Tirmenstein 1991).

Reclamation Potential

Vaccinium vitis-idaea is proven to survive on extremely harsh sites. Well-adapted to fire; vigour and cover increase following a light fire (St-Pierre 1996).

Commercial Resources

Availability: The fruit is commercially produced in Europe and Canada and imported by United Sates (Tirmenstein 1991). Harvested from wild in Nova Scotia and in LaRonge, Saskatchewan.
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: Eurasian cultivars are available for fruit production (Finn and Mackey 2006, St-Pierre 1996) but these are not suitable for reclamation purposes.
Uses: Bog cranberry is an important berry crop in many parts of northern Europe and to a lesser extent in North America. It is primarily wild harvested. Products from the berries include jams, jellies, syrups, juices, sauces candies, wines and liqueurs. Also used as ornamental landscape plants, good for ground covers and edging plants. Arbutin is extracted from the leaves of this plant and used by the pharmaceutical industry to produce preparations to treat intestinal disorders (Marles et al. 2000).

Notes

Vaccinium vitis-idaea is listed as 96% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

As an evergreen shrub, *Vaccinium vitis-idaea* retains its capacity for photosynthesis through the winter. Plants may continue to photosynthesize up to 25% of their annual maximum. This is beneficial in a variety of ways. The plants are able to take advantage of early thaws or temporary breaks in snow cover during the winter. Also, the sugars produced lead to high concentrations of soluble sugars which reduce the damage to leave tissues caused by sudden fluctuations in temperatures (Lundel et al. 2008).

Photo Credits

Photos: Glen Lee, Regina, Saskatchewan.
Photo 3: *Vaccinium_vitis-idaea*_Jonas Bergsten@ wikipedia commons 2012.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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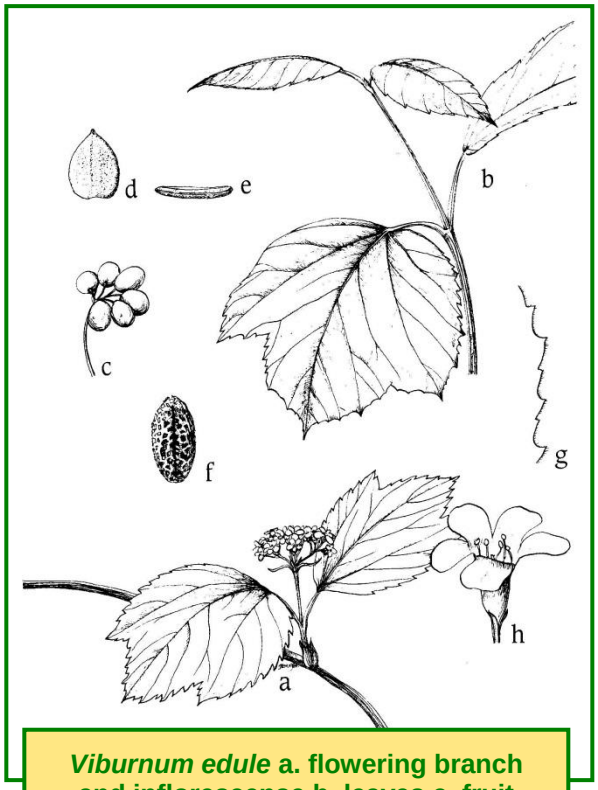
Scientific name: *Viburnum edule* (Michx.) Raf. **Family:** *Caprifoliaceae*

Common Names: lowbush cranberry, mooseberry, squashberry, squawberry, crampbark, pembina



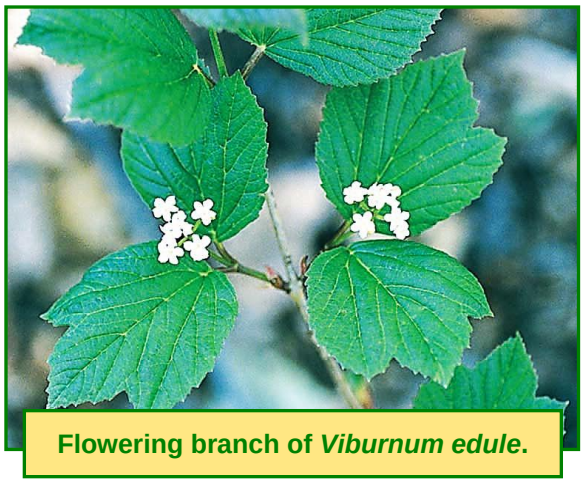
***Viburnum edule* a. flowering branch and inflorescense b. leaves c. fruit d & e. seeds f. pollen g. leaf margin h. individual flower.**

Plant Description

Branching perennial shrub, erect, 1 to 2 m high; glabrous, light grey, moderately slender twigs somewhat six sided with wings at the nodes; opposite ovate to obovate coarsely-toothed leaves often three lobed at apex 6 to 10 cm long; 1 to 3 cm wide cyme at leaf axils of 3 to 30 small white flowers; corolla is 3 to 6 mm long and 4 to 7 mm diameter (Moss 1983).
Fruit: Spherical, light red, 8 to 10 mm long, acid, strong scented, edible drupe, one seed per drupe, 2 to 6 drupes per cluster (Moss 1983).
Seed: 5 to 8 x 5 to 6 mm flattened wedge, flat oval or heart-shaped seeds, flesh-coloured to whitish, ribbed on one face, rough.

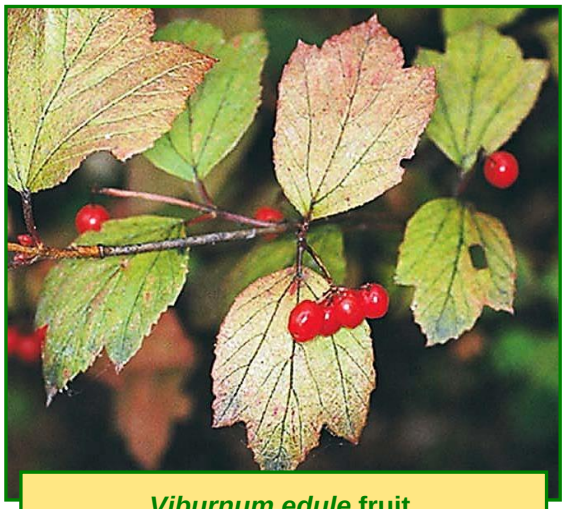
Habitat and Distribution

Moderately shade tolerant. Common in moist woods, thickets, margins of wetlands and stream banks, on rocky gravel banks at higher elevations. Prefers rich moist soils in heavily wooded areas (Inkpen and Van Eyk n.d.).
Picea glauca forests may include lowbush cranberry as a dominant understory species, and as such is moderately shade tolerant. *Populus tremuloides, P. balsamifera* and *Betula papyrifera* groves may also contain some cranberry. Fellow understory species found with *Viburnum edule* include: *Rosa acicularis, Corylus cornuta, Rhododendron groenlandicum, Symphoricarpos albus, Cornus sericea, C. canadensis, Shepherdia canadensis, Chamerion angustifolium, Calamagrostis sp., Salix sp., Alnus* sp., *Rubus sp.* and *Ribes sp.* (Matthews 1992).
Seral Stage: Pioneers in flood plain succession.



Flowering branch of *Viburnum edule*.

Viburnum edule is an important species in all stages of post-fire communities (Matthews 1992).
Soils: Prefers moist, well-drained soils of alluvial origins. Textures range from clay to clay and fine loams with pH 6.5 (Gerling et al. 1996).
Distribution: Widespread across Canada and northern USA. Alberta (parkland and boreal areas). Alaska, Yukon, western District of Mackenzie to James Bay, northern Quebec, Newfoundland south to Oregon, Idaho, Colorado, Minnesota, Pennsylvania (Moss 1983).



***Viburnum edule* fruit.**

Phenology

Flowers mid-April to mid-June. Fruits ripen end of June to first week of July (Banerjee et al. 2001).
In northeastern Alberta, flowering is more common in late June through July with fruit ripening in August and falling toward the end of August, beginning of September.

Pollination

Likely pollinated by bees, butterflies and birds (Dave's Garden n.d.).

Seed Dispersal

Animal dispersal, birds and mammals.

Genetics

2n=18 (Moss 1983).

Seed Processing

Collection: Berries may be sparse on shrubs, although in general the height of bushes facilitates collections.
Seed Weight: 21,740 g/1,000 seeds.
Fruit Volume: 1,770 fruit/L (1,770 seeds/L fruit).
Fruit Weight: 3,030 fruit/kg (3,030 seeds/kg fruit).
Average Seeds/Fruit: 1 seed/fruit.
Harvest Dates: Late July to late August, fruit should be picked when colour changes from green to red-orange (Banerjee et al. 2001).
August 1 to September 30 (Formaniuk 2013).
Cleaning: Mash fruit in a sieve (1.40 mm works well). A blender with taped blades may also be used to macerate the fruit. Suspend residue in water allowing seeds to settle. Decant water and chaff. Repeat suspension and decanting until only seeds remain.
Alternatively, a tomato de-seeder may be used although care must be taken to remove cracked and broken seed. Allow seed to dry at room temperature in a moving air stream.
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: Store dry at low temperatures (Young and Young 1992).
Longevity: At low temperature, dried seeds can be stored for several years (Young and Young 1992). If sealed in containers at 1 to 3°C, seeds can be viable for up to 10 years (Luna 2008, Rose et al. 1998).

Propagation

Natural Regeneration: Sprouting from damaged rootstalks, stem bases, and stumps (Matthews 1992).
Germination: Difficult to germinate due to two year embryonic dormancy. Royal Botanic Gardens Kew (2008) report 75% germination. Emergence in the field is more successful than *in vitro* germination.
Pre-treatment: 1 year cold stratification before seeding (Wood pers. comm.).
180 days stratification (Formaniuk 2013).

3 to 5 month warm moist stratification (22°C) followed by three months cold moist stratification (5°C) (Luna 2008). Seeds are dormant and require a double cold period to initiate germination (Smreciu and Barron 1997).

Mechanical scarification (chipping with scalpel) followed by 250 mg/L GA3 and warm conditions (30°C/20°C and 8 h light/16 h dark) is recommended by Royal Botanic Gardens Kew (2008).

Direct Seeding: In trials on a reclaimed oil sands site, no significant emergence was observed by sowing seeds. When entire fruit were sown, approximately 18% of seeds emerged after five years. Spring sown fruit tend to emerge better than fall sown ones (Smreciu, et al 2012).

Seed Rate: 100 seeds/m², 50 fruit/m².

Planting Density: 790 to 3,200 plants/ha (USDA NRCS n.d.).

Vegetative Propagation: Softwood cuttings (6 cm) in July and August are successful, particularly when treated with rooting hormone powder (auxin) and stuck into flats of perlite until rooting occurs (from six to eight weeks using intermittent mist); then transplant into flats of potting soil (Rose et al. 1998). Stem cuttings collected in June, 20 cm long and 0.5 cm in diameter, with 1/3 of the basal leaves removed, given a two minute fungicide (Domain) bath and treated with 3,000 ppm Hormex rooting powder and placed in rooting media under mist with bottom heat for seven weeks produced 100% rooting (Luna 2008).

Rhizome cuttings can also be successfully established in a greenhouse (Holloway and Zasada 1979). When planted immediately after the fall collection, rhizome cuttings successfully produce roots (Matthews 1992). Plants may regenerate by layering in the summer in sandy soil (Babb 1959).

Rooted cuttings can be slow to grow and may develop secondary bud dormancy.

Greenhouse Timeline: 1 year in greenhouse before out-planting. Plants can be stored over winter for spring or summer plant (Wood pers. comm.). Grow for 170 days before harvest (Formaniuk 2013).

***Viburnum edule* seed, approximately 6 mm x 5 mm.**

Aboriginal/Food Uses

Food: Fruit are cooked to make jelly and cough medicine. Can be eaten fresh, however can cause vomiting and cramps if eaten in large quantities (CYSIP: Botany n.d., Marles et al. 2000). Fruit is an excellent source of vitamin C; flavour is improved if picked after a frost (Royer and Dickinson 1996, Turner 1997).

Medicinal: Chewing twig tips can treat sore throats. Closed buds were rubbed on lips to heal lip sores. Tea made from roots was used as teething pain relief, as a gargle for sore throat and as a blood purifier. Boiled fresh or dried bark was used to relieve menstrual pain (Marles et al. 2000, Royer and Dickinson 1996). Simmered bark acts as an antispasmodic (hence the name crampbark – Gray 2011).

Other: Hollowed out branches were used to make pipe stems and the bark used as a tobacco substitute (Marles et al. 2000, Turner 1997, Wilkinson 1990).

Wildlife/Forage Usage

Wildlife: Highly browsed by game (mostly during winter). The fruit is a valued food source for many bird species (CYSIP: Botany n.d.). Grizzly and black bears, deer, rabbits, chipmunks, squirrels, skunks, grouse, pheasants and many other birds eat the berries. Deer, moose, rabbits, and beaver browse on

the foliage. Provides cover for small mammals and birds (Tannas 1997).
Livestock: Low palatability, little use to livestock (Tannas 1997).
Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

Versatility in cranberry, range of light and soil tolerance (sun, part shade or shade, clays to loams), re-sprout ability and tolerance to disturbance all make this species useful in reclamation applications.

Commercial Resources

Availability: Seed is commercially available in Alberta (ANPC 2010).
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: None are known.
Uses: The fruit can be eaten raw but is more generally used to make jams, jellies and syrups. The plant is sometimes used as an ornamental.

Notes

V. edule is listed as 84% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Fruit are produced at around five years of age, after which the plants produce large crops nearly every year.
V. edule is a seed banking species and soil disturbance resulting from mechanical site preparation can favour germination of stored seed and may provide suitable seedbeds for freshly deposited seed (Matthews 1992).

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Photos 1&2: Colin Stone (Alberta Agriculture), used with permission from *Northern Range Plants*, Alberta Agriculture, Food and Rural Development, Home Study Program, Copyright 2000.
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APPENDIX 3: Grasses and Grass-Like Species

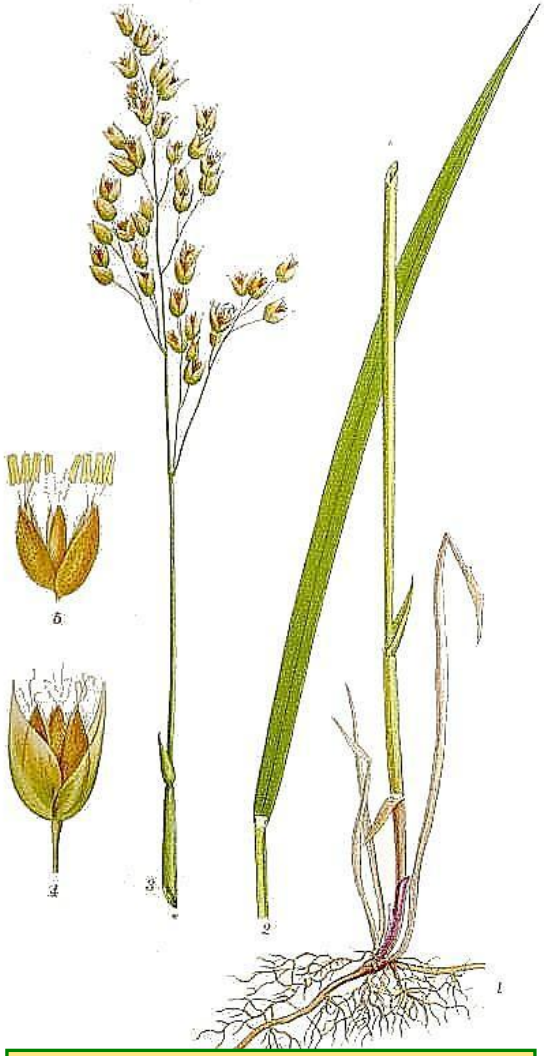
The following grass and grass-like species are profiled in this Appendix.

Scientific Name	Common Name	Family
Anthoxanthum nitens	sweetgrass, vanilla grass, holy grass	Poaceae
Bromus ciliatus	fringed bromegrass	Poaceae
Calamagrostis stricta	boreal reed grass, northern reed grass, slimstem reedgrass	Poaceae
Deschampsia caespitosa	tufted hair grass, tussock grass	Poaceae
Eleocharis acicularis	needle spike rush, needle spike sedge	Cyperaceae
Eleocharis palustris	creeping spikerush, common spikerush, spike sedge	Cyperaceae
Hesperostipa curtiseta	western porcupine grass, Canadian needle grass, shortbristle needle and thread	Poaceae
Leymus innovatus	hairy wildrye, fuzzyspike wildrye, boreal wildrye	Poaceae
Phragmites australis	reed grass, common reed grass, giant reed grass, carrizo	Poaceae
Schizachne purpurascens	false melic, false melic grass, purple oat grass	Poacaeae
Scirpus microcarpus	small-fruited bulrush, panicled bullrush, barber-pole bulrush	Cyperaceae
Sisyrinchium montanum	mountain blue-eyed grass, strict blue-eyed grass	Iridaceae

Scientific Name: Anthoxanthum nitens (Weber) Y. Schouten & Veldkamp

Family: Poaceae

Common Names: sweetgrass, vanilla grass, holy grass



***Anthoxanthum nitens* rhizome (1) blade, (2) flowering culm, (3) pistillate flower, (4) and staminate**

Plant Description

Perennial, sweet, vanilla-smelling grass with flat leaves, extensive rhizomes and small, bronze-colored spikelets (Moss 1983). Culms tufted, 10 to 40 cm tall, with leafy shoots; blades 2 to 20 cm long, flat to rolled, tapering to a blunt point, dark green; slightly roughened to smooth and shiny beneath, smooth and slightly roughened above; veins prominent on both sides and white mid-vein below; margins roughened; rolled at emergence; sheaths round, split, often purplish at base (Tannas 2004).

Fruit/Seed: Three flowered, the terminal floret perfect, the others are staminate or neutral; staminate lemma awnless, firm, brown, boat shaped, hairy (Moss 1983).

Habitat and Distribution

Habitat: Wet meadows, around sloughs in fescue and montane grassland (Tannas 1997). Moist to dry, open areas (Moss 1983).

Seral stage: Is usually found in mid-successional communities. It can tolerate some disturbance (Rook 2000).

Soils: Moist, sandy to heavy clay soils (Walsh 1994). Saline tolerant (Walsh 1994).

Distribution: Circumpolar: Alaska, Yukon, District of Mackenzie to Hudson Bay, northern Quebec, Newfoundland south to Oregon, Nevada, Arizona, South Dakota, Great Lakes (Moss 1983).

Phenology

Flowers form from May to June and the seed is ripe July to early August (Walsh 1994).

Pollination

Wind pollination (NANPS 2003).

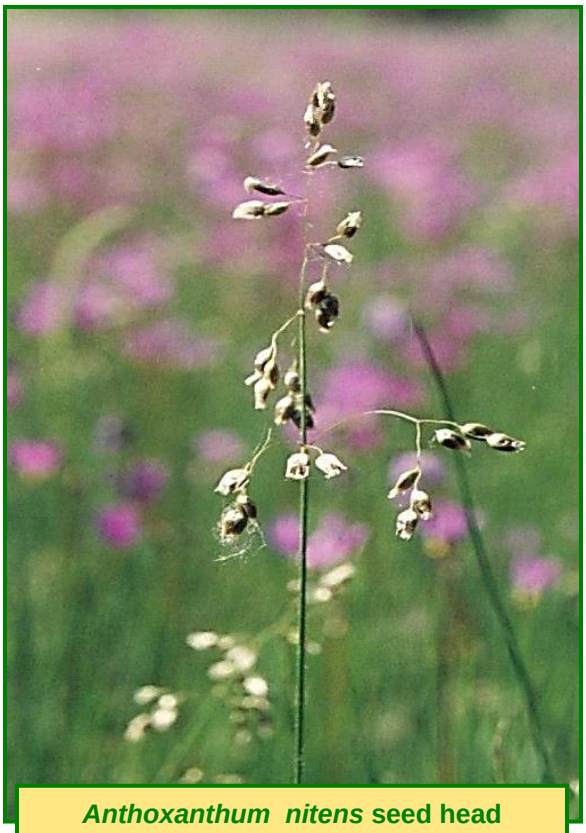
Seed Dispersal

Wind, water and on animal fur (Queensland Government 2013).

Genetics
2n=28, 42, 56 (Moss 1983).

Symbiosis
No literature found.

Seed Processing
Collection: Sweetgrass inconsistently produces seeds. Seeds can be collected in summer by hand picking (Winslow 2001).



***Anthoxanthum nitens* seed head**

Seed weight: 0.41 g/1,000 seeds (Stevens and Winslow 2010). 0.8 to 1.2 g/1,000 seeds (Smreciu et al. 2002).
Harvest Dates: Late June to early August (Walsh 1994).
Cleaning: Dry seed before crushing. Use blowers or screens to remove chaff from seeds (Smreciu et al. 2002).
Storage: Store dry at room temperature (Smreciu et al. 2002).
Longevity: Seed maintains viability up to three years (Smreciu et al. 2002).

Propagation
Natural Regeneration: Can produce by seed or rhizomes (vegetative). New plants are commonly produced vegetatively as many seeds are non-viable (Rook 2000).
Pre-treatment: None required (Smreciu et al. 2002). *Anthoxanthum nitens* requires a period of cold temperatures before it will germinate from seed (Stevens and Winslow 2010). Royal Botanic Garden Kew (2008) stratified the seed at 6°C for 8 weeks.
Vegetative Propagation: Most successful method is by the division of rhizomes (Rook 2000).
Germination: Seed germination tests have averaged 25% to 30%.
100% germination with pre-treatments when germinated on a 1% agar media for 2 weeks at temperatures of 23/9°C (12 hrs day / 12 hours night) (Royal Botanic Gardens Kew 2008).
Plant late fall, late winter, or early spring while keeping seeds moist until seedling emergence, in about 10 to 14 days (Stevens and Winslow 2010). Seedlings grew and survived well in a greenhouse trial (Smreciu et al. 2002).

***Anthoxanthum nitens* seeds**

Aboriginal/Food Uses

Food: Seeds are edible though they were not used as food. Essential oils from the leaves were used as a vanilla flavor additive in candy and drinks (MacKinnon et al. 2009).

Medicinal: Made into medicinal tea for treatment of coughs, sore throat, fever, venereal infection, chafing, windburn, internal pains and sore eyes. Also used to stop vaginal bleeding and help with childbirth. Smoke was also inhaled for cold relief (MacKinnon et al. 2009).

Other: Sweetgrass is a very important plant to the First Nations people in Canada. It is commonly braided and burned as incense; used in ceremonies to cleanse and purify people as well as to bring blessings and protection. Chewed to increase endurance during ceremonial fasting. Used to perfume clothing, repel insects and leaves soaked in water made a sweet hair rinse (MacKinnon et al. 2009). Grass blades were also used for making baskets, mats and sewing material (MacKinnon et al. 2009).

Wildlife/Forage Usage

Wildlife: Less palatable than other grasses because it contains a chemical called coumarin, which causes the grass to have a bitter flavor to grazing animals (Agriculture and Agri-Food Canada 2012).

Livestock: Has good forage value (Tannas 2001).

Grazing Response: Increaser (Wroe et al. 2003).

Reclamation Potential

Deep vigorous rhizomes make it useful as erosion control and slope stabilizer (Walsh 1994).

Commercial Resources

Availability: Are available in Alberta Nurseries (ANPC 2010).

Uses: Medicinal plant (Agriculture and Agri-Food Canada 2012).

Contains a strong anti-oxicidents that can be used to prevent the breakdown of lipids in commercial processing and storage of food products (Grigonis et al. 2004).

Notes

Synonyms include *Hierochloe odorata* (ITIS n.d.).

Photo Credits

Photo 1: Prairie Moon Nursery 2011.

Photo 2: Project Runeberg 2009. Wikimedia Commons.

Photo 3: Wild Rose Consulting, Inc. 2010

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Scientific Name: *Bromus ciliatus* L. **Family:** *Poaceae*

Common Names: fringed bromegrass

***Bromus ciliatus* illustration.**

Plant Description

Loosely tufted perennial grass; robust slender culms 60 to 100 cm high; non-rhizomatous; glabrous or pubescent nodes; glabrous sheaths or short-hairy; flat blades 4 to 8 mm wide; loose, open, drooping panicle 10 to 20 cm long; greenish spikelets 1 to 2 cm long; first glume one-veined and second glume three-veined; long pubescent lemmas 8 to 10 mm long near the edges, glabrous or sparingly hairy on the back with awn 3 to 5 mm long (Tannas 1997).

Seed: 8 to 11 mm long; lemma more or less hairy; awn up to five mm long arising between two teeth at tip of lemma; palea adheres to grain (Pahl and Smreciu 1999).

Habitat and Distribution

Shade tolerant; found in open woods, meadows, fescue grassland and riparian habitat, prairies, thickets, climax and seral coniferous forest communities. Found in moist areas at the perimeter of the prairie and at elevated sites below the tree line; requires 40 cm annual precipitation (Pahl and Smreciu 1999).

Seral Stage: Early.

Soils: Soil pH ranges from 4.8 to 7.9 (Esser 1994). Prefers loam, silty loam and sand, also occurs on stony substrates. Tolerant of moderately acidic soils (Tannas 1997) and has a low tolerance of saline soils (USDA NRCS n.d.).

Distribution: Found across Alberta and North America (Tannas 1997).

Alaska, Yukon, southwestern District of Mackenzie to James Bay, Newfoundland south to California, Arizona, New Mexico, Texas, Nebraska, Great lakes, Appalachia (Moss 1983).

Phenology

Flowers from July to August (Esser 1994). Cool-season perennial; starts spring growth in mid-May; seeds mature by mid-August (Pahl and Smreciu 1999).

Pollination

Wind pollinated (Esser 1994).

Self-pollinating (May et al. 1999).

Seed Dispersal

Wind dispersed with some animal assisted dispersal (awn sticks to fur).

Genetics

2n=14, 28 (Tannas 1997).

Symbiosis

Fringed brome is colonized by arbuscular mycorrhizal fungi and exhibits a neutral response (Wolfe et al. 2006).

Seed Processing

Collection: Seeds can be hand harvested. Use of seed strippers has been recommended by Burton and Burton (2003) but Pahl and Smreciu (1999) note that seeds have a high shattering potential.

Seed Weight: 306 seeds/g (0.33 g/1,000 seeds) (Gerling et al. 1996). 306 PLS/g (Hammermeister 1998).

547 seeds/g (1.75 g/1,000seeds) (Smreciu et al. 2006).

Harvest Dates: August.

Cleaning: Air-dry seed heads in paper or Tyvek bags at 15 to 25°C; remove large chaff and crush remaining material; sieve to remove seeds from chaff using 9/64 inch round top screen and 1/16 inch round bottom screen; small chaff and dust can be removed by winnowing (Smreciu et al. 2006).

Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature Royal Botanic Gardens Kew 2008).

Storage: Seed can be cold stored up to 3 years (Schultz et al. 2001). Royal Botanic Gardens Kew (2008) recommends that these seeds be stored at IPGRI standards; this involves drying seed to low moisture content (3% to 7% fresh weight, depending on the species) and storing them, in hermetically-sealed containers, at low temperature, preferably at -18ºC or cooler (Fassil and Engels 1997).

***Bromus ciliatus* flowers.**

Longevity: The seeds can be stored in a container and refrigerated for up to three years (Schultz et al. 2001).

Propagation

Natural Regeneration: By seed (Gerling et al. 1996). The non-dormant seeds can produce high germination rates (Esser 1994).

Germination: 55.91% after 30 days, fresh seeds and 58.00% after 30 days with one year old seeds (Smreciu et al. 2006).

In his study, Hoffman (1985) reported that *B. ciliatus* germinated to high percentages under various thermaperiods, photoperiods, in darkness, and with or without stratification. The only time it showed less than 100% germination was in light tests following stratification.

Seeds germinated at 24°C (Baskin and Baskin 2001).

Pre-treatment: Not all seed lots are dormant. For dormant seed lots use four weeks cold stratification (2 to 4°C) (Smreciu et al. 2006).
In a container, mix an equal amount of seeds with either perlite or vermiculite and add a very small amount of water and place in a refrigerator (0.5 to 5°C) (Schultz et al. 2001).
No stratification required (Baskin and Baskin 2001).
Direct Seeding: For nursery production: sow January through late July in deep cell plug trays in growing media containing vermiculite and sphagnum peat moss. Thoroughly moisten the soil without saturating it. Place newly planted trays on south side of the greenhouse. During the active growing phase, move trays to the north side. Mature plants can be moved to a cold frame in early to late spring. Flats can be transplanted into the field from late May to early October (Schultz et al. 2001).
Direct sown seed in northeastern Alberta established and began spreading within three years of sowing.
Seed Rate: Three seeds in each plug tray cell (Schultz et al. 2001).
100 seeds/m^2 were sufficient for establishment in northeastern Alberta.
Planting Density: No literature found.

Aboriginal/Food Uses

The grains may become infected with ergot (Claviceps), which is a poisonous fungus. The grain of the infected plants is replaced by a black mass of spores, and this, if eaten by livestock or humans, can cause severe illness or death (Johnson et al. 1995).

Wildlife/Forage Usage

Wildlife: Excellent forage value (Gerling et al. 1996). Small mammals, turkeys and other birds eat the seeds. Highly palatable to deer and elk. Provides excellent cover for rodents, turkeys, quail and band-tailed pigeons (Esser 1994).
Livestock: Good forage value, palatable to livestock, makes excellent hay (Tannas 1997).
Grazing Response: Fringed brome is a decreaser (Gerling et al. 1996).

Reclamation Potential

B. ciliatus has potential as an early successional reclamation species because of its moderate germination and quick growth, which provide valuable cover until slower growing climax species establish (Tannas 1997).
B. ciliatus exhibits medium erosion control and short term revegetation potential as well as high long term revegetation potential (Esser 1994).
Suitable for revegetation of disturbances in the foothills and boreal forests (Pahl and Smreciu 1999).
Exhibits phytoremediation potential (Robson et al. 2003).

Commercial Resources

Availability: Available commercially in Alberta (ANPC 2010).

***Bromus ciliatus* seed. Seed generally 8 to 11 mm long.**

Notes

Bromus ciliatus is listed as 72% intact (more occurrences than expected) in the Alberta oil sands

region (Alberta Biodiversity Monitoring Institute 2014).

In their study, Robson et al. (2003) reported that fringed brome was the species that produced the highest total biomass in their control soil, however, in their contaminated soil (crude oil treatments) its biomass was reduced by more than half.

Because of its high seed yield, fringed brome may have the potential to produce adequate amounts of seeds for revegetation purposes at reasonable prices (May et al. 1999).

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Photo 2: Wild Rose Consulting, Inc.

Illustration: Hitchcock, A.S. (rev. A. Chase), 1950. Manual of the grasses of the United States. USDA Miscellaneous Publication No. 200. Washington, DC.

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Scientific Name: *Calamagrostis stricta* (Timm) Koeler **Family**: *Poaceae*

Common Name: boreal reed grass, northern reed grass, slimstem reedgrass

Plant Description

Rhizomatous monoecious perennial native grass with smooth erect stems up to 90 cm, growing in dense tufts; green blades often rolled inward, up to 5 mm wide; inflorescence is an egg or lance-shaped compact panicle 5 to 12 cm long and 5 to 20 mm wide; spikelets laterally compressed, 2 to 4.5 mm long, 1 to 2 mm wide, one floret per spikelet; glumes smooth and sub-equal, first glume with a tail-like appendage at apex; lemma 2 to 4 mm long, surface dull with hairs on and between the veins, apex notched with bristle-like appendages and with an awn 4 to 4.5 mm long; palea 2 to 4 mm long with smooth veins; florets yellow with 2 styles, 3 anthers 2 to 2.5 mm long, perianth reduced to lodicules (Aiken et al. 1995).

Fruit/Seed: Indehiscent, brown caryopsis (grain) without a stalk (Aiken et al. 1995).

***Calamagrostis stricta* including inflourescence and rhizome**

Habitat and Distribution

Found in imperfectly drained areas such as marshes, damp meadows, along stream banks and lake shores (Aiken et al. 1995). High water use (low drought tolerance), partly shade tolerant, minimum root depth of 17 cm (USDA NRCS n.d.).

Seral Stage: Early to mid seral.

Soil: Acidic, wet to mesic (Gerling et al. 1996), sandy soil (Aiken et al. 1995), pH between 5.5 and 7.5; has a moderate tolerance to salinity and low drought tolerance (USDA NRCS n.d.).

Distribution: Circumpolar; found in all Canadian provinces, Greenland and most of the US, to Arizona in the west and West Virginia to the east (USDA NRCS n.d.).

Alaska, Yukon to Devon Island south to Oregon, Utah, Colorado, southern Saskatchewan, North Dakota, Great Lakes (Moss 1983).

Phenology

Flowers in late spring, May to June, with fruits/seeds maturing in summer (Rook n.d.).

Pollination

Wind pollinated (Rook n.d.).

Seed Dispersal
Wind dispersed with some animal dispersal by granivores.

Genetics
Primarily 2n=28 (Greene 1980) but can be 2n=56, 70 or 84 (Moss 1983).

Symbiosis
Many species of *Calamagrostis* have associations with arbuscular mycorrhizae (Malcova et al. 1999, Puschel et al. 2007, Thormann et al. 1999).

Seed Processing
Collection: Cut stems and allow to dry before threshing.
Seed Weight: 0.17 to 0.22 g/1,000 seeds (Smreciu et al. 2002).
0.086 g/1,000 seeds (Pickseed 2010).
0.032 g/1,000 seeds (USDA NRCS n.d.).
Harvest Dates: Collected late August to early September in northern Alberta and Saskatchewan.
Cleaning: Thresh, shake or rub to separate seed from chaff. Winnow, using blower or screens, to remove chaff.
Storage Behaviour: Likely orthodox, dry to 3% relative humidity and store in sealed containers.
Storage: Store dry at room temperature.
Longevity: Seed remains viable at least four years at room temperature.

Propagation
Natural Regeneration: Spreads primarily by rhizomes, less so by seed (Rook n.d.).
Germination: 70% germination after stratification (Smreciu et al. 2002).
Pre-treatment: 30 days cold stratification (Smreciu et al. 2002).
Direct Seeding: 34 seedlings emerged from 200 seeds/row m (Smreciu et al. 2002).
Planting Density: 4,500 to 7,300 plants per hectare (USDA NRCS n.d.).

***Calamagrostis stricta* florets**

Seed Rate: Seed crops can be grown on upland sites in areas with good soils and high annual precipitation (Tannas 2001).
Vegetative Propagation: In cultivation it is best propagated by root cuttings if soil is dry enough to support machinery (Tannas 2001).

Aboriginal/Food Uses
No known uses.

Wildlife/Forage Usage
Wildlife/Livestock: Moderately palatable to grazers and browsers (USDA NRCS n.d.); used as forage by wood buffalo (Strong and Gates 2009) and lesser white-fronted geese (Markkola et al. 2003).
Grazing Response: *C. stricta* is an increaser under moderate grazing conditions. Seed heads are usually ungrazed in these conditions. It also reproduces rapidly from rhizomes (Tannas 2001). Decreaser when grasslands are grazed heavily (Tannas 2001).

Reclamation Potential
Can be used to reclaim wet meadows, banks and shore sites (Gerling et al. 1996).

Commercial Resources

Harvest Methods: Although untested, it is likely Calamagrostis can be threshed like other grain crops.
Availability: No known commercial sources.
Cultivars: No known cultivars.

Notes

C. stricta is listed as 94% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014). There is some discussion regarding the taxonomy of the subspecies of *Calamagrostis stricta* and related *Calamagrostis* species as these may form a morphologically indistinct complex circumboreal in distribution (Greene 1980). There are several valid subspecies. In Alberta, *C. inexpansa* and *C. stricta* are both present (ITIS 2010, USDA NRCS n.d.). *Calamagrostis stricta* may hybridize with other Calamagrostis species in the wild (Crackles 1997).

Photo credits

Photo 1: Wikimedia commons 2010. http://upload.wikimedia.org/wikipedia/commons/4/42/Calamagrostis_stricta.jpg [Last accessed May 22, 2013].
Photo 2: Wikimedia commons 2010. http://upload.wikimedia.org/wikipedia/commons/6/6e/Calamagrostis_stricta_02.jpg [Last accessed May 22, 2013].

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Scientific Name: Deschampsia cespitosa (L.) Beauv
Family: *Poaceae*

Common Names: tufted hair grass, tussock grass

Plant Description
Culms in dense tuffs, 20 to 120 cm tall with shallow roots, leafy at base; leaves often elongate, mostly 1.5 to 4 mm wide, rather firm, flat or folded; panicle loose open, nodding, 10 to 25 cm long, the capillary branchlets spiklet-bearing toward the tips; 2 flowered spikelets 3 to 5 mm long, pale purplish, shining; glumes 3 to 4.5 mm long; lemmas smooth, 2.5 to 3.5 mm long awn near the base, the callus hairs short (Moss 1983, Pahl and Smreciu 1999).
Fruit/Seed: 2.5 to 3.5 mm long grain with a callus (Pahl and Smreciu 1999).

Tufted formation *Deschampsia cespitosa* ideal for erosion control.

Habitat and Distribution
Moist open areas, high elevation sites; sandy or rocky shores; bogs and fens (Lady Bird Johnson Wildflower Center 2012).
Seral Stage: Early to mid seral.
Soil: A wide range of soil conditions with pH 3.7 to 8.3 (Davy 1980).
Distribution: Alaska to Ellesmere Island south to California, Arizona, New Mexico, South Dakota, Great Lakes, Appalachia (Moss 1983).

Phenology
Short-lived cool season perennial; starts growth in early spring; seeds mature from late June to mid-July (Pahl and Smreciu 1999).

Pollination
Wind; cross-pollinating (Pahl and Smreciu 1999).

Seed Dispersal
Wind.

Genetics
2n=28 (Moss 1983).

Symbiosis
Some colonization by arbuscular mycorrhizae on acidic soils (Goransson et al. 2008).

Seed Processing
Collection: Collect seed heads and place loosely in paper bag so that there is airflow to promote drying

***Deschampsia cespitosa* seed**

(Archibald and Dremann 2004). Seed is hard and brown when ripe (Tilley 2010).
Seed Weight: 0.5 to 0.9 g/1,000 seeds (Smreciu et al. 2002). 5,510 PLS/g (Hammermeister 1998).
Harvest Dates: Late July into early August (Smreciu et al. 2002).
Cleaning: Thresh seed once dry, use blower and or screens to remove chaff (Smreciu et al. 2002).
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents; their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Before planting seed can be stored in cool dry conditions at 10˚C (Tilley 2010). Long-term storage under IPGRI preferred conditions are recommended by Royal Botanic Gardens Kew (2008).
Longevity: Smreciu et al. (2002) found viability was not severely hampered after five years.
The oldest banked collection is 12 years old (mean storage period 11 years) with an average germination reduction from 93.4% to 91.5% (Royal Botanic Gardens Kew 2008).

Propagation

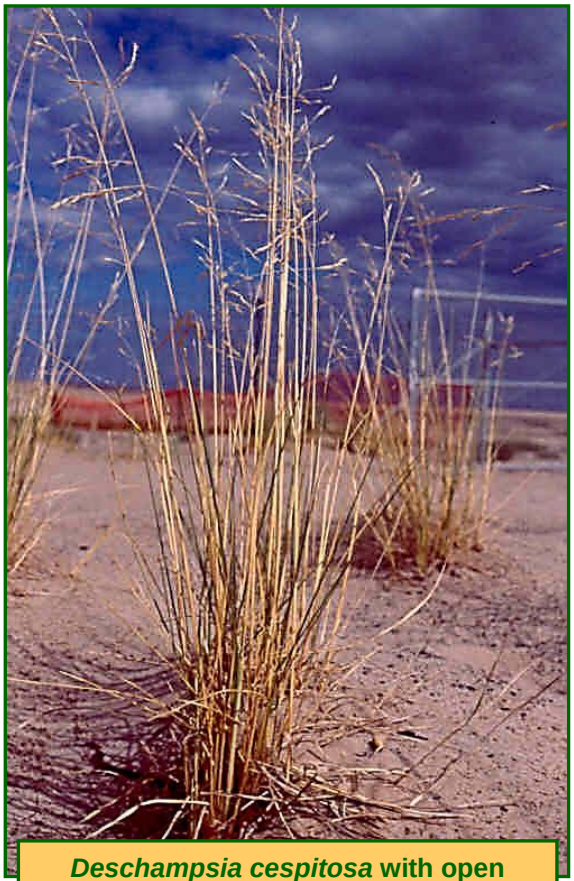
Natural Regeneration: Reproduces primarily by seeds (Tannas 2001).
Germination: First emergence occurs 3 to 5 days after planting at temperatures of 32 to 43°C during the day and about 30°C at night. Full stands (90% to 100%) are reached in 12 days (Tilley 2010).
Pre-treatment: Seed is not stratified before planting (Tilley 2010).
Direct Seeding: Approximately half of seeds emerged on a disturbed test site in northeastern Alberta, however survival was limited (Smreciu et al. 2002).
Seed is difficult to handle with conventional machinery (Tannas 2001).
Does best if seed is sown in the fall (USDA NRCS n.d.).
Seeding Density: 0.056 kg seed/ha to 0.114 kg/ha if species diversity is the end goal, 0.183 kg/ha to 0.367 kg/ha if used as turf (USDA NRCS n.d.).
Vegetative Propagation: No literature found.
Micro-propagation: No literature found.

Wildlife/ Forage Usage

Wildlife: Heavily used in summer by rocky mountain elk and also on occasion by mule deer (Pahl and Smreciu 1999). In native meadows provides cover for birds, water fowl and small mammals. It is also grazed by feral horses in the foothills (Walsh 1995).
Livestock: It is good forage for many types of livestock (Walsh 1995).
Grazing response: Tufted hair grass is a decreaser when exposed to heavy grazing (Walsh 1995).

Reclamation Potential

It is valuable for soil stabilization in disturbed areas and has been found naturally colonizing on abandoned coal mine spoils (Walsh 1995).



***Deschampsia cespitosa* with open panicle**

A highly adaptable species, it can colonize calcareous mine waste and acidified soils.
It is tolerant of heavy metal contamination (Pahl and Smreciu 1999). This species is adapted to tolerate zinc and a variety of other metals (Cox and Hutchinson 1980, Goransson et al. 2008, von Frenckell-Insam and Hutchinson 1993).

Commercial Resources

Availability: Available in a few Alberta nurseries (ANPC 2010). Seed is in short supply and expensive (Tannas 2001). Species is distributed worldwide but only native genetics are suitable for reclamation (Tannas 2001).
Uses: Is used in landscaping as an ornamental plant, as well as food for livestock in native pastures (Walsh 1995).
It is excellent for use as a soil stabilizer in disturbed areas due its ability to tolerate heavy metals, acidic conditions and low nutrient soils (Davy 1980).

Notes

Synonym: *Deschampsia caespitosa* (Tilley 2010).
D. caespitosa is listed as 78% intact (more occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Blokenearexeter 2010. Wikimedia Commons.
Photo 2: Sten Porse 2009. Wikimedia Commons.
Photo 3: Wild Rose Consulting, Inc. 1998.

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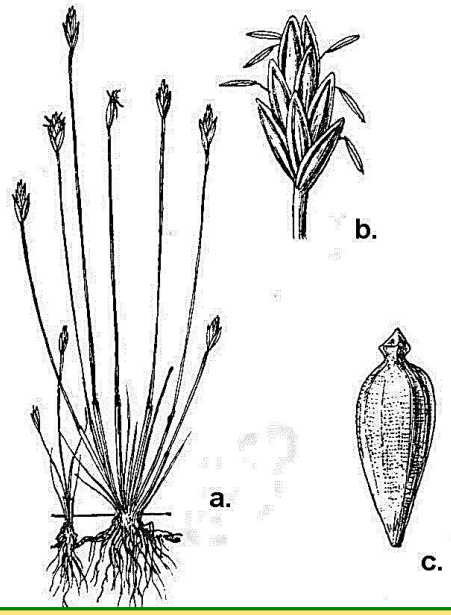
Scientific Name: *Eleocharis acicularis* (L.) Roemer & J.A. Schultes
Family: *Cyperaceae*
Common Names: needle spike rush, needle spike sedge



***Eleocharis acicularis* showing a. inflorescence, culms, leaves, rhizomes and roots, b. flower head, c. achene (seed).**

Plant Description

Grass-like perennial herb with slender creeping rhizomes, forming dense mats and floating masses; loosely tufted culms, needle-like stems, 3 to 12 cm high, angled and grooved; small, inconspicuous needle-like square-tipped leaves located at stem base with pale reddish basal sheaths; single ovate to lanceolate flowering spike at stem tip, 2 to 7 mm long arranged spirally, somewhat flattened consisting of 3 to 15 flowers, reddish-brown scales with green centers; 3 stigmas; submerged plants are usually non-flowering (Moss 1983).
Fruit/Seed: Whitish-straw coloured, slender obovoid achenes 0.7 to 1 mm long, with several longitudinal ridges and many fine transverse lines, tubercle conic with 3 to 4 bristles equal to or slightly longer than achene. Reddish-brown scales with margins and midribs of greenish to straw color (Moss 1983).

Habitat and Distribution

Wet places, marshes, sloughs, mudflats, shallow water of lakes, ponds and streambeds. Adapted to fluctuating water levels. Shade intolerant.
Seral Stage: Establishes well in disturbed areas. Indicative of terrestrialization (Bornette et al. 1994).
Soil: Found on infertile sand and gravel shorelines. pH range of 6.1 to 7.0 (Day et al. 1988).
Found in sandy soils, with low silt and clay content, and low phosphorous levels (Day et al. 1988).
Has a moderate salinity tolerance; intolerant to shade (USDA NRCS n.d.).
Distribution: Common and widespread across Alberta. Circumpolar: Alaska, Arctic coast to Baffin Island (Moss 1983, USDA NRCS n.d.).

Phenology

Flowers June to October (USDA NRCS n.d.).

Pollination

Wind pollinated.

Seed Dispersal

Seed fall off plant and sink in the water. Seed can only travel any significant distance if the water is running (Leck and Schutz 2005).

Genetics

2n=20 (Moss 1983).

Symbiosis

Forms arbuscular mycorrhizae (Barnola and Montilla 1997).

***Eleocharis acicularis* seed**

Seed Processing

Collection: Pick ripe seed head and place in paper bag.

Seed Weight: 0.044 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Storage/Longevity: Orthodox, 1 to 5 years in soil seed bank, little known on method (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: Regenerates primarily by rhizomes, occasionally by seed (Cooper et al. 2006, Rook 2002).

Germination: 40% to 50% germination at warm temperatures (22 to 35°C) after pericarp removed (Yeo 1986).

Seed germinated at 15°C (Baskin and Baskin 2001).

Planting Density: 4,200 to 11,900 plants per hectare (USDA NRCS n.d.).

Pre-treatment: Remove pericarp via mechanical scarification (Yeo 1986).

60 day cold stratification required (Baskin and Baskin 2001).

Vegetative Propagation: 43% survival of rhizome cuttings the first year and 25% survival by year 2 in northeastern Alberta. It spreads extensively in the wet areas.

Micro-propagation: Are micro-propagated to use in decorative ponds, aqua gardens and fish tanks (LiveAquaria.com n.d.).

Aboriginal/Food Uses

Food: No literature found

Medicinal: No literature found.

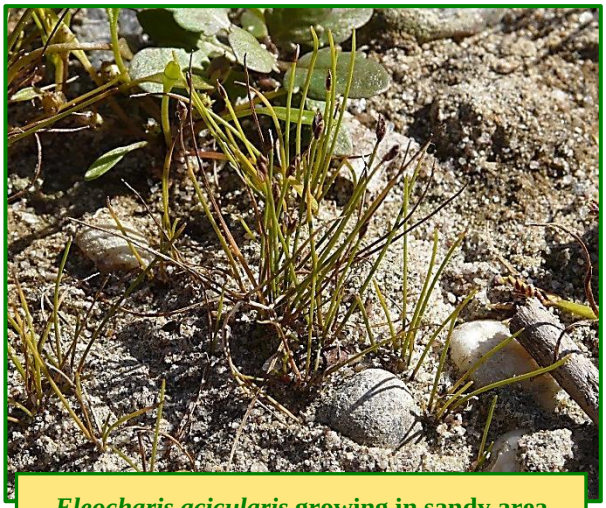
Other: No literature found.

Wildlife/Forage Uses

Wildlife: Provides habitat for amphibians and fish. Seeds and stems are an important food source for waterfowl and mammals (Hamel and Parsons 2001).

Livestock: No literature found.

Grazing Response: No literature found.



***Eleocharis acicularis* growing in sandy area**

Reclamation Potential

Well-adapted to nutrient-poor, high-stress habitats. Tolerates stress due to its small stature, slow growth rate and evergreen tissues (Day et al.

1988). Spike-rush helps stabilize shorelines (Hamel 2001).
Hoang et al. (2009) found *Eleocharis acicularis* to accumulate heavy metals from contaminated mine sites and to be a hyper-accumulator of lead (Pb). Has also been found to accumulate Sb, As, Cu and Zn in a study by Ha et al. (2009).

Commercial Resources

Available from numerous Alberta and Saskatchewan nurseries.
Cultivars: None are known.

Photo Credits

Photo 1: Prairie Moon Nursery 2012.
Photo 2: Bernd Sauerwein @ Wikimedia Commons 2012.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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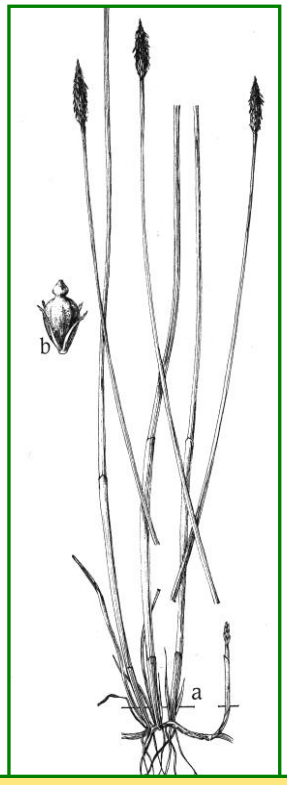
Scientific Name: *Eleocharis palustris* L. **Family:** *Cyperaceae*

Common Names: creeping spikerush, common spikerush, spike sedge

Plant Description

Perennial, graminoid in growth, with stout creeping rhizomes, forming dense mats (stands can be 30 cm to 2 m in diameter (Hauser 2006)); tufted culms, somewhat flattened stems 10 to 100 cm high; leaves are bladeless sheaths at base of stems; single, narrowly ovoid to lanceolate spikelet at stem tip, conical and brown, 0.5 to 2 cm long; 1 to 3 sterile scales at base of spikelet, fertile scales are lanceolate and acute and usually have firm mid vein to the apex; 2 stigmas.
Fruit/Seed: Yellow-brown lens-shaped achenes 1 to 1.5 mm long, conical swelling at tip (half the width of the achene), usually 4 barbed bristles somewhat longer than achene.

Eleocharis palustris flower head.



Eleocharis palustris ***a.*** **showing roots and rhizomes and flowering stems and leaves. b. achene**

Habitat and Distribution

Wet places, marshes, wet meadows, ditches, mud flats, along stream banks, lakeshores and flood areas. It is shade tolerant and drought intolerant (Hauser 2006). Adapted to saturated sites or areas of seasonal inundation.
Seral Stage: Early colonizer on newly developed wetlands; decreases with competition but can be found in all seral stages. Grows well on disturbed sites (Hauser 2006).
Soil: Grows in a variety of soils: alkaline, sandy loams, sedimentary peat, organic loams (Hauser 2006).
Soil pH ranges from 4 to 8 (Hauser 2006).
Adapted to coarse and fine textured soils, it can withstand anaerobic soil conditions and is found on heavy clays (Hauser 2006).
Distribution: Common and widespread across Alberta and across North America, north to the tree line. Circumpolar: Alaska, Yukon to Hudson Bay, northern Quebec and Newfoundland (Moss 1983, USDA NRCS n.d.).

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Phenology

Active growth period is spring, with moderate growth rate (USDA NRCS n.d.). Flowers from June to September. Seeds ripen in late August to October (USDA NRCS n.d.).

Pollination

Wind-pollinated (Hauser 2006).

Seed Dispersal

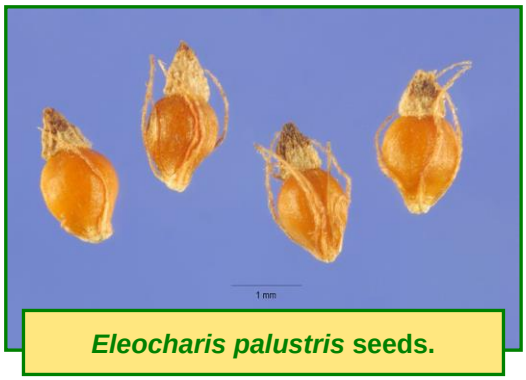
Seed from *Eleocharis sp.* do not float so are not carried very far unless water in the area is flowing (Leck and Schutz 2005).

Genetics

2n=10 to 96 (USDA NRCS n.d.).

Symbiosis

Colonized by vesicular-arbuscular mycorrhizal fungi (Bohrer et al. 2004). According to Ogle et al. (2012) common spikerush is associated with VA mycorrhizae and has the ability to fix atmospheric nitrogen and make it available to other plant species in the wetland community.



***Eleocharis palustris* seeds.**

Seed Processing

Collection: Harvest by hand, stripping or clipping with hand shears (USDA NRCS n.d.). Power seed harvesters may also be used (Ogle et al. 2012). Handheld seed strippers can be used in dense patches.
Can produce prodigious amounts of seed but viability is low (Hauser 2006).

Seed Weight: 0.76 g/1,000seeds (Royal Botanic Gardens Kew 2008).
Cleaning: Hammer mill can be used to break up large debris and free seeds (Ogle et al. 2012).
Storage/Longevity: Orthodox, long term with IPGRI preferred storage conditions (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: Spreads rapidly by rhizomes and occasionally by seed (Ogle et al. 2012). Rhizomes are most productive in mid to late summer (Hauser 2006). Establishes areas by colonization when not able to seed (Rook 2002).
Germination: Should start germinating after 7 to 14 days (Ogle et al. 2012). Light, moisture, and heat are required for seed germination (USDA NRCS n.d.). 75% germination success average (Royal Botanic Gardens Kew 2008).
Promoted by stratification (Hauser 2006).
Pre-treatment: Light seed scarification followed by 30 to 45 days cold stratification (2ºC) in a mixture of water and sphagnum moss (Ogle et al. 2012).
8% germination after 30 days following a 9-month cold stratification at 4ºC (Shipley and Parent 1991).
Direct Seeding: 5% germination rate, after 5 years of growth, germinated seeds were firmly established and thriving (Hauser 2006).
Maximum seeding density of 47,000 seeds/ha (USDA NRCS n.d.).
Vegetative Propagation: 63% survival of rhizome sprigs (Tannas 1997) the first year and 42% survival by year 2; spreads extensively in wet areas.
Use of plugs with spacing of 30 to 45 cm to allow for fill will provide suitable establishment (Ogle et al. 2012).

Wildlife/Forage Uses

Wildlife: Important food source and cover for waterfowl (Hauser 2006). Also provides cover for many small mammals. Seeds, stems and rhizomes are an important food source for a variety of waterfowl, marsh and songbirds. Seeds are eaten by

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ducks and the shoots by geese (Ogle et al. 2012).
E. palustris has fair food value for elk and mule deer (Hauser 2006).
Livestock: Tops are heavily grazed by livestock especially after seed set. *E. palustris* may increase in response to grazing (Hauser 2006).
Low palatability (Hauser 2006).
Grazing Response: Although Tannas (1997) notes it is fairly resistant to heavy grazing and trampling, Hauser (2006) states it is highly susceptible to trampling in wetland areas.

Reclamation Potential

Common spikerush can be used for wetland restoration and for development and improvement of plant diversity in wetland and riparian habitats (USDA NRCS n.d.). Reported to naturally colonize reclaimed wetland sites in the oil sands region of Alberta (Cooper et al. 2006). Because of its extensive rhizome formation, it is good for erosion prevention and for soil building (Tannas 1997).

Commercial Resources

Availability: Not available commercially in Alberta or Saskatchewan (Tannas 1997).
Cultivars: Numerous cultivars are available in the U.S. but these are not suitable for reclamation in Alberta.

Notes

Because of its sprouting rhizomes, the common spikerush is well adapted to fire. The underground rhizomes usually remain undamaged by fire because the common spikerush grows in saturated or flooded soils (Hauser 2006).
Negatively affected by invasive *Elaeagnus angustifolia* and found to be in association with Canada thistle at some locations (Hauser 2006).
Shade intolerant (Rook 2004).

Photo Credits

Photo 1: Kristian Peters @ Fabelfroh 2007 (UTC).
Photo 2: Steve Hurst
http://plants.usda.gov/java/profile?symbol=ELPA3&photoID=elpa3_003_ahp.tif
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Hesperostipa curtiseta* (A.S. Hitchc.) Barkworth
Family: *Poaceae*

Common Names: western porcupine grass, Canadian needle grass, shortbristle needle and thread

Plant Description

A perennial bunch grass, 40 to 60 (100) cm tall with roots to 1 m; old leaf sheaths remain in crowns of older plants; panicles 15 to 20 cm long, fully exerted, narrow, nodding, with slender branches each bearing 1 to 2 spikelets; spikelets relatively large, one-flowered giving rise to a single seed; glumes papery, often bristle-tipped, noticeably longer than the lemma; leaves up to 5 mm wide, light green, shiny, generally flat, ridged and rough on upper surface, smooth below; sheath round, split, white or purplish at base, prominently-veined, with translucent, hair-fringed margins; ligule up to two mm long, blunt or rounded, sometimes notched or split, fringed with hairs; auricles absent (Moss 1983).

Seed: 12 to 15 mm long with a sharp-pointed, hairy callus; lemma brown, hairy at the base and margins, strongly rounded; awn prominent, 5 to 11 cm long, twice-bent with the last segment straight, twisted below; seed hulls (lemma and palea) remain attached to seed (Moss 1983).

Ripe seed heads of western porcupine grass.

Habitat and Distribution

Prairie grasslands, prairies, parklands and rocky mountains. Western porcupine grass is an indicator of dry grasslands. In the boreal forest region it is found only on the driest, open microsites with rapid, complete drainage (Schwarz and Wein 1999).

Seral Stage: Appears mid to late successional stages.

Soils: Prefers medium textured loamy and mesic soils with medium soil texture (Gerling et al. 1996). Is not recommended for use on saline soils.

Distribution: Dominant species on loam soils in the central part of the Canadian prairies; British Columbia, southern District of Mackenzie to southern Manitoba south to Montana, South Dakota (Moss 1983).

Phenology

Long-lived, cool season perennial; grass growth begins in mid-April, flowers in mid-June, seed ripens early to mid-July and then shatters approximately two weeks later (Coupland and Brayshaw 1953). In boreal regions seeds can shatter as early as mid-July.

Pollination

Wind; presumed out–crosser.

Seed Dispersal

No literature found.

Genetics

2n=46 (Moss 1983).

Seed of *Hesperostipa curtiseta*. Seeds are generally 12 to 15 mm long exclusive of the awn.

Seed Processing

Collection: Although seeds can be harvested by hand, hand held strippers can be used in large stands. Do not store seed in cotton or burlap bags as awns will become entangled in the cloth.

Seed Weight: Seed weights can vary depending on growing areas. Smreciu et al. (2006) report 12.5 g/1,000 seeds average from seeds harvested in northeastern Alberta whereas Pahl and Smreciu (1999) measured 5 to 6 g/1,000 seeds.

Fruit/Seed by Weight: 178,000 seeds/kg in southern and central Alberta (Pahl and Smreciu 1999).

Harvest Dates: Mid July in north-eastern Alberta (Smreciu et al. 2006).

Cleaning: Seeds need to be debearded and this is best done at lower seed moistures. Seed screen can be used to clean seeds from chaff (top screen 4/64 x ½ slotted; bottom screen 6 x 24 mesh) (Pahl and Smreciu 1999).

Storage Behaviour: Likely Orthodox, seeds can be dried, without damage, to low moisture contents; longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).

Storage: 100% viability following drying to 15% moisture content and freezing for 4 months at 20°C (Royal Botanic Gardens Kew 2008).

Longevity: Unknown.

Propagation

Natural Regeneration: Rhizomes or seeds (Gerling et al. 1996).

Germination: 19% after 30 days using fresh seeds, and 39% after 30 days using one-year-old seeds (Smreciu et al. 2006); 45% in 6 to 14 days if stratified; 52% in 6 to 14 days given a gibberelic acid treatment after piercing seeds (Pahl and Smreciu 1999).

Pre-treatment: Four weeks cold stratification (2 to 4°C) or GA treatment of pierced seeds.

Seeding Depth: 2 to 4 cm (Pahl and Smreciu 1999); 3 to 6 cm (Weaver 1931).

Seed Rate: In cultivation, 100 to 164 seeds/linear m of row.

Vegetative Propagation: Spring burning stimulates reproductive performance, but fall fires reduce cover and seed production (Bailey and Anderson 1978).

Aboriginal/Food Uses

Stiff ends used to make hair brushes (Walkup 1991).

Wildlife/Forage Usage

Wildlife: Good forage value for ungulates (Tannas 1997).

Livestock: Low to good forage value (Gerling et al. 1996). Good palatability. Mature seed can cause irritation in the mouths and gums of domestic livestock, for this reason they avoid grazing the plant once the seeds have been produced (Tannas 1997). Considered one of the most important native forages in Canada's mixed prairies (Coupland and Brayshaw 1953).
Grazing Response: Canadian needle grass is a decreaser (Gerling et al. 1996, Saskatchewan Forage Council 2007).

Commercial Resources

Availability: Limited quantities of seeds are occasionally available in Alberta.
Cultivars: None known.

Notes

Synonym – *Stipa spartea* (Walkup 1991). *Hesperostipa curtiseta* is a moderately competitive plant and grows well under *Elaeagnus commutata* (Nernberg and Dale 1997).

Photo Credits

Photo 1: Colin Stone (Alberta Agriculture) used with permission from "Northern Range Plants Alberta Agriculture, Food and Rural Development Home Study Program, Copyright 2000".
Photo 2: Wild Rose Consulting, Inc.

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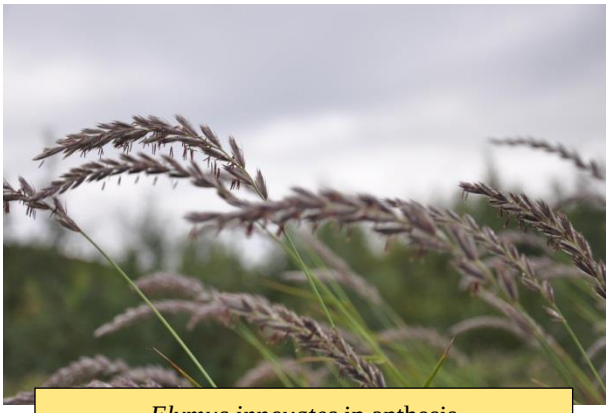
Scientific Name: *Leymus innovatus* (Beal.) Plig. **Family:** *Poaceae*

Common Names: hairy wildrye, fuzzyspike wildrye, boreal wildrye



Elymus innovates in anthesis

Plant Description

Tufted, perennial grass forming slender creeping rhizomes. Culms are mostly 40 to 100 cm tall. Leaves firm, flat, 2 to 5 mm wide, glabrous beneath, scabrous above, often glaucous; ligule truncate, 0.5 mm long or less, auricles long, prominent and claw-like. Spike 4 to 10 cm long, rather dense, purplish or grey villose. Glumes narrow, densely villose; Lemmas broader and coarsely villose; awns mostly 1 to 4 mm long (Moss 1983).
Seed: Approximately 1 cm long and 0.2 cm wide, pale, lenticular (Burton and Burton 2003).

Habitat and Distribution

Open woodlands in deciduous and coniferous forests or in montane grasslands (Tannas 1997).
Seral Stage: Early to mid seral.
Soil: Associated with sandy soils under open *Populus* and *Pinus* stands. Grows on nutrient poor soils with a tolerance to shade and mildly saline soils (Hardy BBT 1989).
Distribution: Throughout Alberta. Alaska, Yukon, southern District of Mackenzie to James Bay south to British Columbia, Montana, Wyoming, South Dakota (Moss 1983).

Phenology

Greens up in March and April (Alberta), flowers in June to July also into September in Montana (Williams 1990).

Pollination

Wind pollinated.

Seed Dispersal

Mostly by gravity with help from the wind and occasionally by animals (Williams 1990).

Genetics

2n=28, 56 (Moss 1983).

Symbiosis

No literature found.

Seed Processing

Collection: Seed heads can be harvested by hand and dried in the sun (Burton and Burton 2003).
Seed Weight: 18 g/1,000 seeds (Burton and Burton 2003). 392 PLS/g (Hammermeister 1998).
Harvest Dates: Late July to early August.
Cleaning: Use a fanning mill (prescreen 2.5 x 19 mm slot; top screen 4 x 19 slot; bottom blank) followed by a vacuum separator to remove dust and chaff (Burton and Burton 2003).
Storage: Store cool and dry in airtight containers.
Longevity: No literature found.

Propagation

Natural Regeneration: Regenerates from rhizomes.
Germination: Germinates well with no pre-treatment (Burton and Burton 2003).
Pre-treatment: No pre-treatment required (Burton and Burton 2003).
Vegetative Propagation: Potential for root cutting success (Tannas 1997).

Wildlife/Forage Usage

Wildlife: Stone sheep, elk and bison graze hairy wild rye (Williams 1990).

Livestock: Poor palatability but fair to excellent forage value when alternatives are absent (Burton and Burton 2003, Hardy BBT 1989).

Grazing Response: An increaser, spreading readily by rhizomes, decreasing under forest canopy (Tannas 1997).

Reclamation Potential

Excellent choice for revegetation; rhizomes provide erosion control and allow for rapid colonization of disturbed areas.

Is relatively tolerant of acid and salt resulting from disturbance (Tannas 1997).

In lab tests, *Leymus innovatus* grew well on sandy soils saturated with various levels of oil, so has potential for rehabilitation of hydrocarbon-contaminated sites (Hardy BBT 1989).

Commercial Resources

Availability: Seeds and plants are commercially available in Alberta (ANPC 2010). However, to ensure material is properly adapted, local collection is preferred.

Notes

Synonym *Elymus innovatus* (Williams 1990).

Hybridizes with *Agropyron dasystachyum*, *A. smithii* and *A. trachycaulum* (Moss 1984).

Leymus innovatus is listed as 99% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo: Wild Rose Consulting, 2013.

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Scientific Name: *Phragmites australis* (Cav.) Trin. ex Steud.
Family: *Poaceae*

Common Names: reed grass, common reed grass, giant reed grass, carrizo

Plant Description

Perennial grass 1.5 to 4 m tall, reed-like; rhizomes stout, creeping, about 3 cm in diameter; leaf blades are flat and hairless (10 to 40 cm long); sheaths loose; ligule composed of hairs; plume-like flower cluster (10 to 40 cm long), branches ascending to drooping and covered with long silky hairs; tawny or purplish spikelets 1 to 12 flowered and up to 2 cm long; palea shorter than lemmas (Moss 1983, Royer and Dickinson 2007).
Fruit: Caryopsis (Royer and Dickinson 2007).

Habitat and Distribution

Edges of wetlands and marshes (Royer and Dickinson 2012).

***Phragmites australis* in flower**

Seral Stage: Common reed is considered both a pioneer and a climax species. It regenerates and establishes well on disturbed sites and is often considered a weedy or nuisance species. Generally, it is shade intolerant, appears early in primary open water succession, and sprouts rapidly after top-killing disturbances (Gucker 2008).
Soil: Coarse to fine textures soil, pH 4.5 to 8.7, high salinity tolerance, shade intolerant (USDA NRCS n.d.). Can tolerate salt concentrations up to 40.6 dS/m (Royal Botanic Gardens Kew 2008).
Distribution: Circumpolar, boreal. British Columbia to Nova Scotia, generally distributed to the south (Moss 1983).

Phenology

Flowers July to August (Royer and Dickinson 2007).

Pollination

Wind pollinated (Tannas 2004). Some self-pollination has been reported (Gucker 2008).

Genetics

2n=36, 48, 54, 72, 84, 96 (Moss 1983).

Symbiosis

Form associations with arbuscular mycorrhizal (AM) and dark septate endophytic (DSE) fungi (Dolinar and Gaberščik 2010).

Seed Processing

Collection: Strip seed off the plant and store in paper bag until seed can be cleaned.
Seed Weight: 0.11 g/1,000 seed (Royal Botanic Gardens Kew 2008).
Harvest Dates: July or August.
Cleaning: Screen and winnow seeds until all chaff is gone.

Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: IPGRI preferred conditions (Royal Botanic Gardens Kew 2008).
Longevity: Oldest collection at Royal Botanic Gardens Kew is 15 years old and germination only changes from 93% to 90% (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: By seed but spread more aggressively by rhizomes (Gucker 2008, Tannas 2004). Rhizomes can extend 5 to 10 m (Lady Bird Johnson Wildflower Center 2007).
Germination: Have achieved germinations rates 86% to 95% on a 1% agar media conditions varying. The highest germination rate was incubated at 35°C day/20°C night and received 8 hrs of light and 16 hrs night (Royal Botanic Gardens Kew 2008).
Pre-treatment: No pre-treatment was required (Royal Botanic Gardens Kew 2008).
Planting Density: 8,500 to 11,900 plants/hectare (USDA NRCS n.d.).
Direct Seeding: Difficult to grow from seed, recommend starting seedlings in greenhouse, once seedlings are established they spread rapidly from rhizomes (Tannas 2004).
Easily grown, surface sow in spring, without shade (Plants for a Future n.d.).
Vegetative Propagation: Divide in spring, any section with bud can grow a new plant (Plants for a Future n.d.).
Micro-propagation: Embryonic calli are produced in florets from inflorescences when exposed to 2,4-dichlorophenoxyacetic acid (Lauzer et al. 2000).

Aboriginal/Food Uses

Food: Root can be cooked like potato with up to 5% sugar, best when young and growing. Roots can also be dried and ground for porridge or starch.
Young shoots are good raw or cooked (potherb).
Dried leaves can be ground to add to dumpling flour.
Seeds are edible raw or cooked or dried and ground into flour. Sugar can be extracted from stalks with a sweet liquorice flavour. Stems may be boiled in water and the water boiled down to extract sugar as well. A sugary gum can be rolled into balls and eaten as sweets (Plants for a Future n.d.).
Medicinal: Leaves can be used to treat bronchitis and cholera. A decoction of flowers can treat cholera and food poisoning. The stem is an antiemetic and the root is an antiasthmatic, antiemetic, diuretic, sedative and stomachic and used to treat a variety of digestive illnesses (Plants for a Future n.d.).
Other: Used to make rope, baskets and mats by a number of native groups (Tannas 2004).
Flowers can produce a light green dye or be used as brooms (Plants for a Future n.d.).

Wildlife/Forage Usage

Wildlife: Provides good cover for wetland wildlife species (Lady Bird Johnson Wildflower Center 2007).
Livestock: Good forage for livestock, quality of forage does decrease as the season advances when the foliage becomes more fibrous (Tannas 2004).
Grazing Response: Increaser (Tannas 2004).

Reclamation Potential

Useful for stabilizing wet areas and it has been used to treat industrial wastewater (Tannas 2004).
Stabilizes banks and gradually builds soil, raising banks in time (Plants for a Future n.d.).
Able to tolerate the presence of heavy metals (Zn, Pb, Cd, Cu and others) and can be used as a bio-accumulator (Ye et al. 1998).
Difficult to eradicate once established (Plants for a Future n.d.).

Commercial Resources

Availability: No literature found.
Cultivars: No literature found.
Uses: No literature found.

Notes

Synonym *Phragmites communis* (Gucker 2008).

Photo Credits

Photo 1: Wikimedia commons, 2012.

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Scientific Name: *Schizachne purpurascens* (Torr.) Swallen ssp. *purpurascens*

Family: *Poaceae*

Common Names: false melic, false melic grass, purple oat grass

Plant Description

Slender perennial, loosely tufted; culms erect from a short-decumbent base, 40 to 80 cm tall, very slender, sheaths closed; ligules 0.5 to 1.5 mm long; blades are flat; inflorescence an open lax panicle, the branches single or in pairs, more or less drooping, bearing 1 to 2 awned spikelets about 2 cm long, disarticulating above the glumes and between the florets; unequal glumes, shorter then adjacent lemma, purple at base; lemma lanceolate, long hairy callus; awns as long as lemma or longer (Moss 1983).

Seed: Dark brown, dry caryopsis, lanceolate, 1 to 2 mm long.

Habitat and Distribution

Common throughout Alberta. A woodland species, found in aspen, mixed wood and coniferous forests, in montane areas, openings in wooded regions (Tannas 1997).

Seral Stage: Early to mid seral.

Soil: Most commonly found on coarse textured soils in northeastern Alberta.

Distribution: British Columbia, District of Mackenzie to James Bay, northern Quebec, Newfoundland south to New Mexico, South Dakota, Great Lakes; Southern Alaska, southern Yukon (Moss 1983).

Phenology

A cool season grass that blooms in June (Prairie Originals 2009). Seed ripens in July.

Pollination

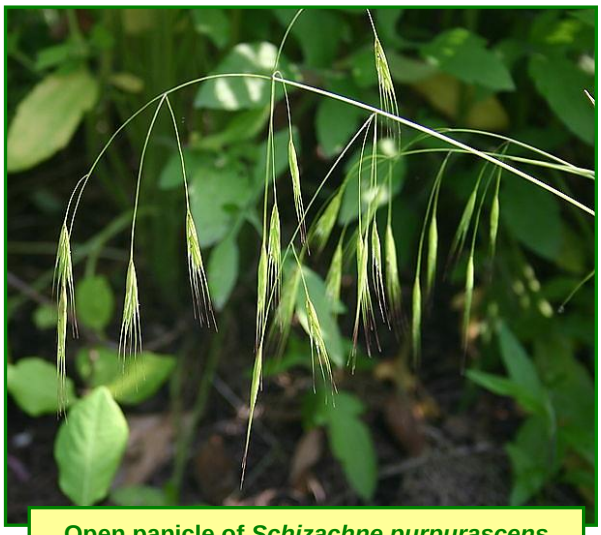
Wind (Friedman and Barrett 2009).

Seed Dispersal

Wind and animals. Awns can catch on passing mammals fur.

Genetics

2n=20 (Moss 1983).



Open panicle of *Schizachne purpurascens*

Symbiosis

None known.

Seed Processing

Collection: Can be harvested by hand into breathable bags.

Seed Weight: 1.70 g/1,000 seeds.

Harvest Dates: Harvested at the end of July in northeastern Alberta.

Cleaning: Air-dry seed heads in paper or Tyvek bags at 15 to 25°C. Remove large chaff and crush remaining material. Small chaff and dust can be removed by winnowing.

Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increase (Royal Botanic Gardens Kew 2008).

Storage: Preliminary results show that viability drops rapidly after a year of cool dry storage. 90% viability following drying to 15% moisture content and freezing for 186 days at -20°C (Royal Botanic Gardens Kew 2008).
Longevity: No literature found.

***Schizachne purpurascens* seeds.**

Propagation

Natural Regeneration: By seed (Friedman and Barrett 2009).
Germination: 90% germination in fresh seed.
Pre-treatment: None required.

Aboriginal/Food Uses

No literature found.

Wildlife/Forage Uses

Livestock: Poor protein levels with high amounts of fiber; only a moderately palatable food source (Tannas 1997). Has fair forage value for beef herds (Saskatchewan Agriculture, Food and Rural Revitalization n.d).
Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

Of limited value in erosion control, *Schizachne* is not yet generally used in reclamation seed mixes (Tannas 1997).

Commercial Resources

No literature found.

Notes

S. purpurascens is listed as 76% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Is a host for the larvae of the northern pearly-eye butterfly (*Enodia anthedon)*(Government of Canada 2010, Prairie Originals 2009).

Photo Credits

Photo 1: Wild Rose Consulting, Inc.
Photo 2: SB Johnny. 2008. Wikimedia common.

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Tannas, K., 1997. Common plants of the western rangelands. Volume 1 – Grasses, grass-like species, trees and shrubs. Lethbridge Community College, Lethbridge, Alberta. 311 pp.

Scientific Name: *Scirpus microcarpus* J.& C. Presl

Family: *Cyperaceae*

Common Names: small-fruited bulrush, panicled bulrush, barber-pole bulrush

Plant Description

Solitary, stout, triangular culms, leafy, 30 to 100 cm tall (1.5 m – Plants for a Future n.d.) from thick, stoloniferous caudex; linear leaves 1.2 to 0.5 cm wide, sheathes tinged red; inflorescence in a large compound umbel, rays spreading or ascending; leaf-like involucral bracts, mostly three, longest often exceeding inflorescence; spikelets ovoid, 3 to 4 mm long; ovate scales marked with green and black, whitish bristles (Moss 1983). Flowers have both male and female parts (Plants for a Future n.d.).

Seed: Whitish lens-shaped achene, obovate, around 1 mm long, apiculate (Moss 1983). Fruit is a pale, smooth achene (Seven Oaks Native Nursery n.d.) 0.7 to 1.6 × 0.8 to 1 mm in size (eFloras.org n.d., GoBotany n.d.).

***Scirpus microcarpus* in flower**

Habitat and Distribution

Found in marshy places (Moss 1983); obligate wetland species (GoBotany n.d., Prairie Moon Nursery n.d.). Forms extensive communities with deep-binding rhizomes that offer good bank and shoreline protection (Hale et al. 2005, Seven Oaks Native Nursery n.d.).

Scirpus microcarpus is found in fresh (<2 mS/cm) waters with seasonal saturation / moderate deep flowing / fluctuating water table (Alberta Environment 2008). In a survey of US Great Plains wetlands (Sletton and Larson 1964) *S. microcarpus* was found to occur in sites with slightly brackish water (mean 0.534 mS/cm with a range of 0.305 to 0.922) and a mean pH of 7.94.

Shade tolerant (Elliot 2003, Plants for a Future n.d.) or shade intolerant (GardenGuides.com n.d.).

Seral Stage: Found in communities at varying successional stages (Elliot 2003).

Soils: Wet soils (Lady Bird Johnson Wildflower Center 2007) with high water holding capacity (Elliot 2003).

Tolerant of a wide pH range (Plants for a Future n.d.); but not acid tolerant (Granite Seed and Erosion Control n.d.).

Distribution: Throughout Alberta. Southern Alaska, Yukon, southern District of Mackenzie, Hudson Bay to Newfoundland south to California, Arizona, New Mexico, Nebraska, Michigan, West Virginia (Moss 1983).

Phenology
Blooming in summer months May through July (Elliot 2003).

Pollination
Wind pollinated (Plants for a Future n.d.).

Seed Dispersal
No literature found.

Genetics
2n=66 (Moss 1983).

Symbiosis
No literature found.

Seed Processing
Collection: Collect in late summer to early fall (Elliot 2003). Seeds ripen June to July (Plants for a Future n.d.).
Seed Weight: 0.06 g/1,000 seeds (Prairie Moon Nursery n.d.).
0.10 g/1,000 seeds (Granite Seed and Erosion Control n.d.).
0.13 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
0.16 g/1,000 seeds (Barner 2007).
Seed per Fruit: No literature found.
Harvest Dates: No literature found.
Cleaning: Barner (2007) used a Westrup Model LA-H laboratory brush machine, with a #20 mantel, at medium speed. Lot was then air-screened using an office Clipper, first with a top screen, 24x24 wire and a bottom screen, blank, medium speed, low air, lot was screened again with a top screen, 1/20 round and a bottom screen, blank, medium speed, low air.
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: Cold storage at 0.5 to 3.3 ^{o}C (Barner 2007).
Longevity: 5.64 years at -20 ^{o}C (Royal Botanic Gardens Kew 2008).

Example of red tingeing at base of *Scirpus microcarpus* stem

Propagation
Natural Regeneration: Rhizomatous.
Germination: 87% to 100% germination (Royal Botanic Gardens Kew 2008).
Germinate in a cold frame with 3 cm of standing water (Plants for a Future n.d.).
Pre-treatment: Cold stratification for 2 to 3 months under moist conditions (Elliot 2003).
Direct Seeding: Can be direct seeded.
Seed Rate: Seed at 1.1 to 2.2 kg PLS/ha (Granite Seed and Erosion Control n.d.).
Planting Density: 4,250 to 12,000/ha (GardenGuides.com n.d.). Oregon Department of Environmental Quality (n.d.) recommends mass plantings (large clumps) of plugs with a minimum size of 15 cm.
Plant in fall 2.5 to 5.0 cm deep (Hansen 2012). GardenGuides.com (n.d.) recommends minimum planting soil depth of 30 cm. Soil should be kept saturated with no more than 15 cm of standing water

until plants are rooted and over 38 cm tall (North Fork Native Plants n.d.).
A sod containing *S. microcarpus* can be planted in water depths up to 25 cm and can tolerate depths up to 30 cm after the first growing season (North Fork Native Plants n.d.).
Rhizome cuttings should be planted 30 to 45 cm apart (Elliot 2003).
Vegetative Propagation: Collect rhizomes while plant is dormant in winter (Elliot 2003).
Micro-propagation: No literature found.
Greenhouse: Sow seed in a cold frame as soon as it is ripe in a pot standing in 3cm of water. Only just cover the seed with soil. The seed usually germinates fairly quickly. Prick out the plants when large enough to handle and plant out in their permanent positions in early summer. Division in spring is easy; larger divisions can be planted out direct into their permanent positions. Pot up the smaller divisions and grow them on in a lightly shaded position in a cold frame, planting them out once they are well established in the summer (Plants for a Future n.d.).

Aboriginal/Food Uses

Food: Roots and stem are rich in starch and can be eaten raw or cooked. The pollen is rich in protein and can be added to flour when making bread (Plants for a Future n.d.).
Medicinal: Poultice of roots was applied to abscesses (Mechling 1959, Plants for a Future n.d.).
Other: Fresh green rushes were woven into mats, mattresses and baskets (Hansen 2012, Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Birds frequent stands and muskrats and amphibians seek refuge in the dense growth (Hansen 2012). Provides food and cover for fish, waterbirds, song birds, small mammals and ungulates (North Fork Native Plants n.d.).
Livestock: Valuable forage for livestock (Hale et al. 2005). When healthy, these plant communities can provide tonnes of forage per hectare compared to kilograms per hectare in nearby upland areas (Hale et al. 2005).
Grazing Response: Decreases under heavy grazing (Hale et al. 2005).

Reclamation Potential

Rhizomatous habit makes *Scirpus microcarpus* good for soil stabilisation in reclaimed pond areas (Lady Bird Johnson Wildflower Center 2007). Can re-establish quickly when disturbance is removed (Hale et al. 2005). Considered invasive – once established can outcompete, displace or overrun other species (Jepson Herbarium n.d.).
Olds College (n.d.) has planted *S. microcarpus*, along with *S. acutus* and *S. validus*, in one of three demonstration wetland polishing ponds.

Commercial Resources

Availability: Seed is widely available.
Cultivars: No literature found.
Uses: No literature found.

Notes

Synonyms *S. microcarpus* J. Presl & C. Presl var. *longispicatus* M. Peck, *S. microcarpus* J. Presl & C. Presl var. *rubrotinctus* (Fernald) M.E. Jones, *S. rubrotinctus* Fernald (USDA NRCS n.d.).
S. microcarpus is listed as 90% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Leaves are sharp – plant was called "cut-grass" by some First Nations groups (Hansen 2012).

Photo Credits

Photo 1: Wikimedia commons [Accessed August 20, 2012].
Photo 2: Matt Lavin 2007.

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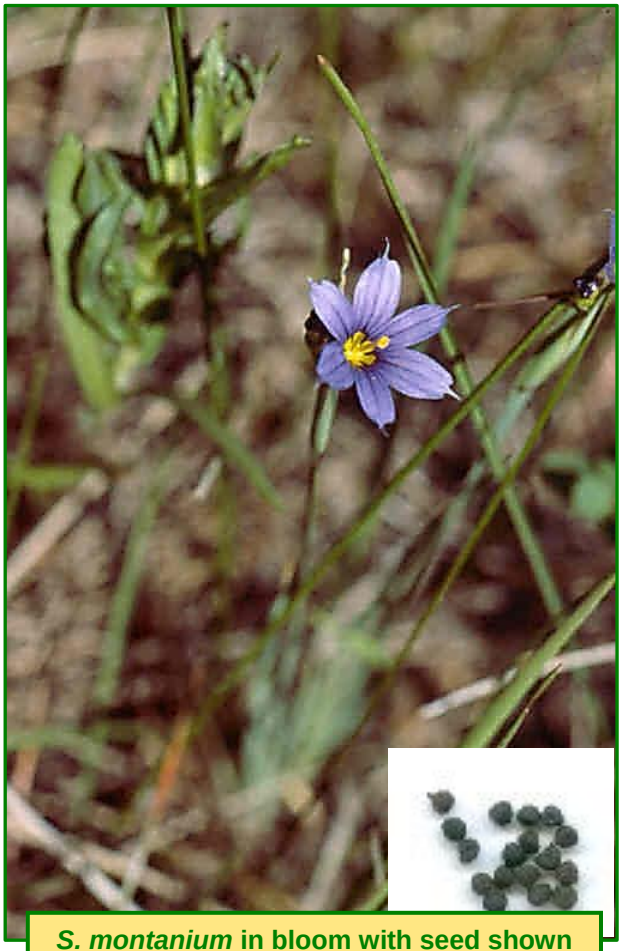
Scientific Name: *Sisyrinchium montanum* L. Green **Family:** Iridaceae

Common Names: mountain blue-eyed grass, strict blue-eyed grass



***S. montanium* in bloom with seed shown in the bottom right.**

Plant Description

Perennial, grows in small clumps; tufted, erect, 1 to 5 dm tall with stiff, flattened stems 1 to 4 mm wide; leaves 1 to 3.5 mm wide, hairless, narrowly linear with winged margins, mostly basal; bracts of spathe are unequal, with the inner about half the length of the outer (outer 2 to 6 cm long), pale green to purplish in colour; inflorescence solitary or in small clusters on a long, leafless stalk; flowers about 1 cm long, 6 mm in diameter, blue-violet; perianth segments spreading, nearly alike, notched or abruptly narrowed into tip at apex; roots fibrous, wrinkled, and originate from a short rhizome (Currah et al. 1983, Moss 1983).

Fruit: Globose capsule with 3 compartments, 3 to 6 mm long, light brown when ripe; contains many seeds (Currah et al. 1983, Wilkinson 1999).

Seed: Dull black, globose to ovoid, 1mm long (Currah et al. 1983).

Habitat and Distribution

Common throughout most ecoregions; found in open grasslands in foothills and northern regions; restricted to depressional grassland and moist meadows in drier prairies (Tannas 1997).

Seral Stage: Early successional (Tannas 1997).

Soil: Tolerant of a variety of soil types and moisture regimes.

Distribution: Southern Yukon, western District of Mackenzie to Newfoundland South to Colorado, southern Saskatchewan, southern Manitoba, Great Lakes (Moss 1983).

Phenology

Emerges in May, with buds produced May to June, flowering occurs June to July, seeds mature July to August (Currah et al. 1983).

Pollination

Iridaceae family are mostly pollinated by insects (Proctor and Yeo 1972).

Seed Dispersal

Seeds potentially spread via birds (Froehlich 2013).

Genetics

2n=96 (Moss 1983).

Symbiosis

Mycorrhizal (Currah et al. 1983).

Seed Processing

Collection: Hand harvest just as the seed capsule turns brown. If collected earlier, collect with stems and dry with stems attached.
Seed Weight: 0.81 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: July to mid-August (from data collected in Alberta and Manitoba), earlier with increasing altitude and latitude (Morgan et al. 1995).
Cleaning: Shake seed free of capsule. Winnow or screen if necessary.
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: 55 % viability following drying to moisture content in equilibrium with 15 % relative humidity and freezing for 11 months at -20°C (Royal Botanic Gardens Kew 2008).
Longevity: No literature found.

Propagation

Natural Regeneration: Grows readily from seed (Lady Bird Johnson Wildflower Center 2012). Self seeds; a few plants can develop into a much larger colony given a few years (Froehlich 2013).
Germination: Currah et al. (1983) obtained no germination both before and after stratification, and noted germination may not occur for up to 2 years following planting.
Froehlich (2013) obtained germination indoors in cool conditions of 10 to 15°C after cold stratification. She also noted that if this is not immediately successful, the seeds can still be placed outside where they will germinate "in their own time".
Royal Botanic Gardens Kew (2008) obtained 75% germination with the pre-treatment described below.
Pre-treatment: Seed imbibed on 1% agar for 10 weeks at 25/10°C, then scarified (chipped with scalpel); germination medium = 1% agar + 250 mg/l gibberellic acid (GA3); germination conditions = 20/10°C, 8 hrs day/16 hrs night (Royal Botanic Gardens Kew 2008).
Froehlich (2013) suggests stratifying seeds in trays in the fridge or a cold room for 6 weeks.
Direct Seeding: No literature found.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: Division of mature plants in spring (Currah et al. 1983).
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: No literature found.
Medicinal: Taken as a cathartic by the old or boiled and used to treat fevers (Moerman 2013). Other native peoples used the roots to make tea for diarrhoea, and the entire plant to make tea for stomach aches and to expel intestinal worms (Johnson et al. 1995). Herbalists have made the plant into a tea for menstrual disorders and for birth control (Johnson et al. 1995).

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: Poor forage value; grazed only if better quality species not present; possibly mildly toxic (Tannas 1997).
Grazing Response: Increaser; a strong population may be an indication of overgrazing (Tannas 1997).

Reclamation Potential

S. montanum often naturally moves into disturbed areas, and it is able to grow in a wide range of soils and moisture regimes (Tannas 1997).

Commercial Resources

Availability: No literature found.
Cultivars: No literature found.
Uses: Decorative; sometimes used in gardens (Froehlich 2013).

Photo Credits

Photo 1: Wild Rose Consulting, Inc.

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APPENDIX 4: Forbs

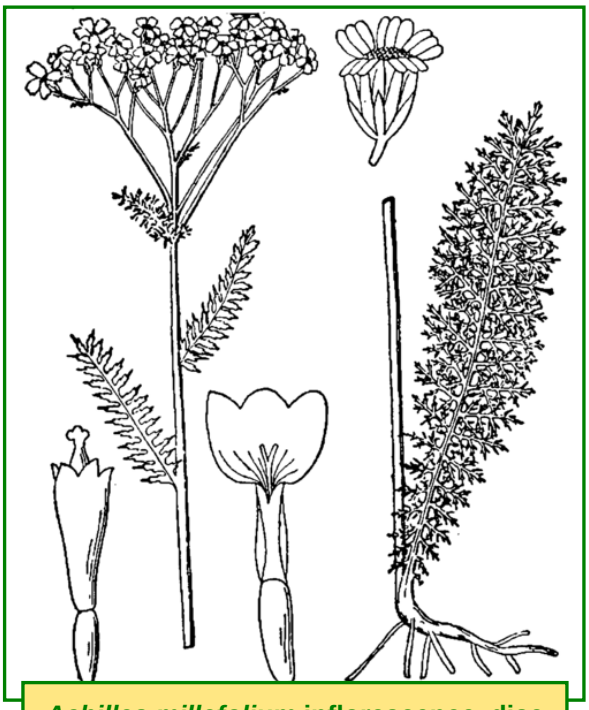
The following forb species are profiled in this Appendix.

Scientific Name	Common Name	Family
Achillea millefolium	common yarrow	Asteraceae
Acorus americanus	rat root, sweet flag, calamus	Araceae
Actaea rubra	baneberry	Ranunculaceae
Anemone canadensis	Canada anemone, meadow anemone	Ranunculaceae
Anemone multifida	cut-leaf anemone, globe anemone	Ranunculaceae
Anemone patens	prairie crocus, crocus anemone, pasqueflower	Ranunculaceae
Apocynum androsaemifolium	spreading dogbane, bitterroot, flytrap, Indian hemp	Apocynaceae
Aralia nudicaulis	wild sarsaparilla	Araliaceae
Astragalus agrestis	cock's-head, field milkvetch, purple milkvetch	Fabaceae
Astragalus alpinus	alpine milkvetch	Fabaceae
Astragalus americanus	American milk vetch, rattlepod	Fabaceae
Astragalus canadensis	Canadian milkvetch, Canada milk-vetch	Fabaceae
Campanula rotundifolia	American milk vetch, rattlepod	Campanulaceae
Castilleja miniata	common red paintbrush, giant red Indian paintbrush, scarlet paintbrush	Scrophulariaceae
Castilleja raupii	purple paintbrush, Raup's Indian paintbrush	Scrophulariaceae
Chamerion angustifolium	fireweed, great willow-herb	Onagraceae
Comandra umbellata	bastard toadflax, pale comandra	Santalaceae
Cornus canadensis	bunchberry, bunchberry dogwood, creeping dogwood, pigeonberry	Cornaceae
Corydalis aurea	golden corydalis, golden smoke, scrambled eggs	Fumariaceae
Cypripedium acaule	moccasin flower, pink lady's slipper, pink lady's-slipper orchid, pink moccasin flower, stemless lady's slipper	Orchidaceae
Draba nemorosa	woodland draba	Brassicaceae
Drosera rotundifolia	round-leaved sundew	Droseraceae
Fragaria virginiana ssp. glauca	wild strawberry, Virginia strawberry	Rosaceae
Galium boreale	northern bedstraw, sweet scented bedstraw, fragrant bedstraw	Rubiaceae
Geranium bicknellii	Bicknell's geranium, Bicknell's cranesbill	Geraniaceae
Geum rivale	purple avens, water avens, chocolate-root	Rosaceae
Hedysarum alpinum	alpine sweetvetch, alpine sweet broom, licorice root, sweetbroom	Fabaceae
Hedysarum boreale	boreal sweet-vetch, boreal sweetvetch, northern sweetvetch, sweetvetch	Fabaceae
Heracleum sphondylium ssp. Montanum	common cow parsnip, cow parsnip	Apiaceae

Scientific Name	Common Name	Family
Lathyrus ochroleucus	cream pea, creamy peavine, pale vetchling peavine	Fabaceae
Lilium philadelphicum	tiger lily, wood lily, prairie lily, wild lily, red lily, western red lily	Liliaceae
Linnaea borealis	northern twinflower	Caprifoliaceae
Maianthemum canadense	wild lily-of-the-valley, false lily-of-the-valley, Canada mayflower	Asparagaceae
Melampyrum lineare	cow-wheat, narrowleaf cow-wheat	Orobanchaceae
Mentha arvensis	wild mint, field mint	Lamiaceae
Mertensia paniculata	bluebell, tall lungwort, tall bluebell	Boraginaceae
Mitella nuda	bishop's cap, bare-stem bishop's-cap, miterwort, naked miterwort	Saxifragaceae
Oxytropis splendens	showy crazyweed, showy locoweed, showy pointvetch	Fabaceae
Primula pauciflora var. pauciflora	saline shooting star, darkthroat shooting star	Primulaceae
Pyrola asarifolia	common pink wintergreen, liverleaf wintergreen, shinleaf wintergreen, pink pyrola	Ericaceae
Rubus chamaemorus	cloud berry, bake-apple, baked-apple berry	Rosaceae
Rumex aquaticus	western dock	Polygonacaeae
Solidago canadensis	Canada goldenrod, common goldenrod	Asteraceae
Solidago simplex var. spathulata	mountain goldenrod, spike-like goldenrod, sticky goldenrod	Asteraceae
Symphyotrichum laeve	smooth aster, smooth blue aster, purple aster	Asteraceae
Symphyotrichum puniceum var. puniceum	purple stem aster	Asteraceae
Trientalis borealis	northern starflower	Primulaceae
Vicia americana	peavine, wild pea, American vetch, wild vetch	Fabaceae

Scientific Name: *Achillea millefolium* L. **Family:** *Asteraceae*

Common Names: common yarrow



***Achillea millefolium* inflorescence, disc flower, ray flower, single head, basal leaf and rootstock**

Plant Description

Rhizomatous aromatic herb; stems are mostly 30 to 70 cm tall, sparsely to densely woolly-villose; leaves, alternate along the stem as well as in basal tuft, two or three times pinnately divided into many narrow segments, ultimate divisions sharply pointed; basal leaves are petioled, plume-like, 3 to 10 cm long; cauline leaves are shorter and sessile; flower heads borne in a dense cluster, round topped to flattish umbel formation; involucre 4 to 5 mm high; bracts pale or dark margined; white rays, approximately 5 per flower, 2 to 3 mm long surrounding 10 to 30 disc-flowers (Moss 1983).

Fruit/Seed: 2 mm long, grey, oblong, flattened, narrow winged margin, longitudinally striate (Currah et al. 1983).

Habitat and Distribution

Grasslands, mountain and boreal regions of Alberta. Found on prairies, in clearings, along roadsides and on disturbed sites, ubiquitous.
Seral Stage: Early pioneer species that persists throughout succession (Aleksoff 1999).
Soil: Medium textured soil with a pH of 6 to 8, low tolerance to salinity and moderate tolerance to drought (USDA NRCS n.d.).
Distribution: Throughout Alberta. Circumpolar: Alaska, Yukon to northern Hudson Bay, northern Quebec, Newfoundland, ubiquitous south (Moss 1983).

Phenology

Flowers from May until freeze-up, seeds generally ripen in late summer (Currah et al. 1983).

***Achillea millefolium* seed**

Pollination

Insect pollinated; self-incompatible (Pahl and Smreciu 1999, Plants for a Future n.d.).

Seed Dispersal
By wind (Aleksoff 1999).

Genetics
2n=18, 27, 36, 45, 54, 72 (Moss 1983).

Symbiosis
Yarrow forms mycorrhizal associations with vesicular-arbuscular fungi (Currah and Van Dyk 1985).

***Achillea millefolium* in bloom**

Seed Processing
Collection: Seeds can be hand-picked by snipping stems into bags or harvested with hand-held strippers (fine brush stripper with a vacuum attachment) if sufficient plant density occurs (Burton and Burton 2003).

Seed Weight: 0.16 g/1,000 seeds (Gerling et al. 1996).

0.12 g/1,000 seeds (Burton and Burton 2003).

Harvest Dates: August.

Cleaning: Air-dry seeds in paper or Tyvek bags at 15 to 25ºC. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens (ASTM #12 or #14). Small chaff and dust can be removed by winnowing.

Storage Behavior: Orthodox; can be dried to lower moisture contents and stored at low temperatures (Royal Botanic Gardens Kew 2008).

Storage: Store cool and dry (Luna et al. 2008). International Plant Genetic Resources Institute (IPGRI) preferred storage conditions; low moisture content (3% to 7% fresh weight, depending on the species) and storing them, in hermetically-sealed containers, at low temperature, to 18ºC or cooler (Fassil and Engels 1997).

Longevity: Can survive at least 5 years under cool dry conditions (Burton and Burton 2003). Oldest collection is 15 years old with viability of 98% at IPGRI preferred storage conditions (Royal Botanic Gardens Kew 2008).

Propagation
Natural Regeneration: Naturally regenerates from seeds and by extensive rhizome system (Gerling et al. 1996).

Germination: 1 to 3 months to germinate (Plants for a Future n.d.).

Pre-treatment: Cold stratification may be required for certain seed lots. Although some seed lots require no stratification, dormant lots can be stratified or given alternating moistening and drying at 22 to 29°C (Pahl and Smreciu 1999).

Seeds get 90% to 100% germination; 14 days to germinate at 22°C (Luna et al. 2008).

Direct Seeding: 60 to 90 cm row spacing. Sow in spring or autumn. Surface seeding (Pahl and Smreciu 1999).
Planting Density: 1,900 to 7,700 plants/ha (USDA NRCS n.d.).
Seed Rate: 375 seeds/m^2 (Pahl and Smreciu 1999).
Vegetative Propagation: Rhizome cuttings may be taken in spring or fall, and mature plants can be divided (Currah et al. 1983).
Micro-propagation: Tissue culture is possible (Turker et. al. 2009).

Aboriginal/Food Uses

Food: Can be eaten raw or cooked, they have a slight bitter flavour. The leaves are best when they are young (Plants for a Future n.d.). If eaten in large quantities it is possible to experience sedative and/or diuretic effects; can be harmful if consumed over long periods of time (Plants for a Future n.d.).
Medicinal: Yarrow's diaphoretic (increases sweating) properties make it one of the best herbal teas to fight fever (Gray 2011).
Flower heads can be chewed and applied to treat a number of skin afflictions, such as burns, bee stings, or sores; also it could be placed in the nostril to stop nosebleeds. Flower decoctions can be ingested to treat menstrual cramps, labour pains and haemorrhaging, coughs or liver ailments as well as sinus and chest congestion. Sometimes a reduced concoction might be used to treat the skin as well. It may be added to other herbs as a painkiller. Smoke of burning yarrow may also be used for pain relief and fumigation of areas occupied by the ill and infectious. The root may be used in a decoction to treat fever, teething sickness and toothaches. The alkaloids identified, although relative amounts vary widely throughout the species, have been shown to have weak fever reducing and blood pressure alleviating effects (Gray 2011, Marles et al. 2000).
Other: Leaves and flower heads are both made into essential oils and used for aromatherapy (Gray 2011). Also used in combination with other leaves to bait traps for lynx (Marles et al. 2000). Used to coat sled dog feet to heal wounds, to lubricate pads to keep snow from building up, and to stop licking (Gray 2011).

Wildlife/Forage Usage

Wildlife: Several authors suggest yarrow is browsed by deer and goats (Plants for a Future n.d., Tannas 2004).
Livestock: Poor forage value due to low palatability (Tannas 2004).
Grazing Response: An increaser. *Achillea* is an indicator of overgrazing, very resistant to trampling and a common component in altered rangeland (Tannas 2004).

Single inflorescence of *A. millefolium.*

Reclamation Potential

In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that *A. millefolium* invaded plots and showed significant increase in prevalence at around 15 to 20 years and continued to increase over the subsequent time periods.
An early seral species with rhizomatous habit, *Achillea millefolium* could spread through an open area relatively quickly, providing groundcover. It is not generally persistent, and as a native species, most other natives are already adapted to sharing their environment with yarrow (Pahl and Smreciu 1999, Tannas 2004).

Commercial Resources

Availability: Seeds and plants are commercially available in Alberta (ANPC 2007). It is recommended that seed be collected locally for use in reclamation.

Cultivars: There are many including: 'Fireland', 'Terracotta', 'Summer Pastels', 'Salmon Beauty', 'Royal Tapestry', 'Red Velvet', 'Red Beauty', 'Peggy Sue', 'Paprika', 'Little Susie', 'Lavender Beauty', 'Laura', 'Hoffnung', 'Heidi', 'Apple Blossom', 'Colorado', 'Cassis', 'Cerise Queen' (Perennials.com n.d.). However, cultivars are not suitable for use in reclamation.

Uses: Often used as an ornamental in dried arrangements or horticultural in gardens (Perennials.com n.d.). Can be used as a hops substitute in beer, essential oils made from the flowers are used in soft drink flavoring and a tea can be made from its flowers and leaves (Plants for a Future n.d.). Yarrow is used in Europe in phytotherapy products as well as an anti-inflammatory both internally (stomach tonic) and externally (skin rashes and sores) (Marles et al. 2000). The antimicrobial nature of yarrow is also recognized and attributed to monoterpenes and polyacetylenes (Marles et al. 2000).

Photo Credits

Photo 1: Hurst, S. USDA-NRCS PLANTS Database. Public Domain.

Photo 2: Salguero, A. Wikimedia commons 2005.

Photo 3: SriMesh. Wikimedia commons 2008.

Line Diagram: Britton, N.L. and A. Brown Illustrated flora of the northern states and Canada. Public Domain.

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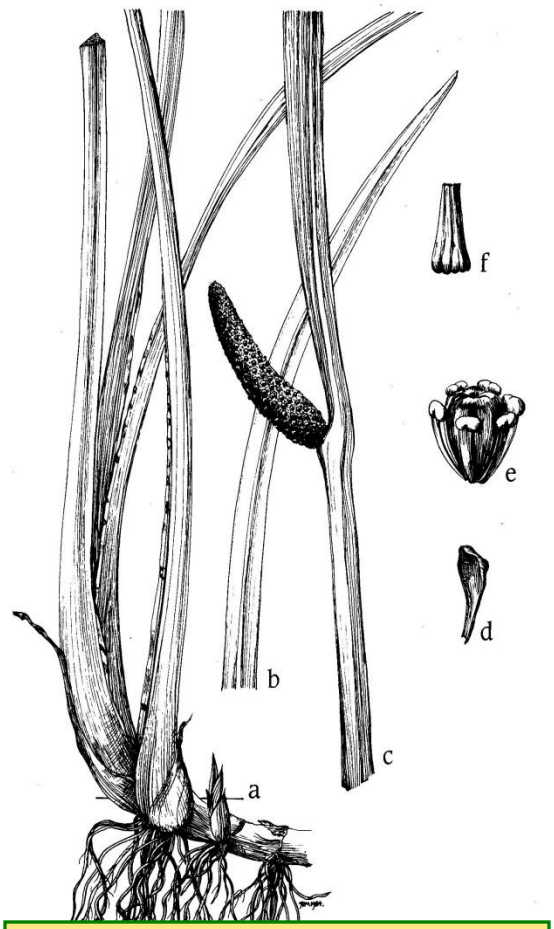
Scientific Name: *Acorus americanus* (Raf.) Raf. **Family:** *Araceae*

Common Names: rat root, sweet flag, calamus



***Acorus* sp. a. leaves, rhizome and roots b. leaf c. flowering stalk d. bract e. stamens and pistil f. seed.**

Plant Description

Herbaceous perennial from thick rootstocks; aquatic erect perennial herb, 40 to 80 cm growing from an aromatic thick, creeping rhizome often forming mats; leaf-like erect stem bears a lateral spadix 3 to 8 cm long; leaves basal, alternate, 40 to 80 cm long and 8 to 20 mm broad, linear, flat; stem/scape resembles leaves; spadix borne laterally partway up the flat stem, 3 to 8 cm long, covered with yellow-brown flowers; flowers perfect, 6 scale-like sepals, ovary 2 to 3 loculed, thick creeping rootstock (Moss 1983).
Fruit: Hard dry fruit, gelatinous inside, bearing a single achene (Johnson et al. 1995).
Seed: 3 mm, lentiform seeds, cream coloured.

Habitat and Distribution

Marshes, shallow water and stream edges, ephemeral streams and swamps (Moss 1983).
Habitat: Emergent species (Baskin and Baskin 2001).
Soils: Organic, poorly drained soils. Moist soils found in riparian areas. Sweet flag is intolerant of droughty soils, but tolerant of seasonal and permanent flooding with 15 to 50 cm maximum water depths (Cooper et al. 2006).
The pH range is 5 to 7, weakly acid to weakly basic conditions (Bush 2001). *Acorus calamus* (possibly *Acorus americanus*) was found in the highest alkaline locales in a fen of south central Ohio (Choesin and Boerner 2000).
Distribution: Central and northern Alberta; British Columbia to Nova Scotia, south to Montana, Texas and Florida. Scattered across southern boreal forest (Moss 1983).

Phenology

Flowers May to August. Seeds ripen late summer or early fall in US (Bush 2001). Flower July to August and seed ripens mid to late September in northern Alberta.

Pollination

Based on morphology, Cook (1988) suggests that *Acorus* is insect pollinated.

Seed Dispersal

Acorus sp. spread seed by water (eFloras n.d.).

Genetics

2n=24 (Moss 1983).

Symbiosis

Plants from Ohio (*A. calamus*) have vesicular-arbuscular mycorrhizal (Bohrer et al. 2004).

***Acorus americanus* seed**

Seed Processing

Harvest Dates: Late summer or early fall (Bush 2001).

Collection: Heads can be handpicked or snipped.

Seed Weight: 0.526 to 0.922 g/1,000 seeds (0.746 average).

Cleaning: Air-dry fruit at 15 to 25°C. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing.

Storage: Store in sealed containers.

Propagation

Natural Regeneration: By seed (Bush 2001) and by rhizome.

Germination: Smreciu et al. (2012) found that fresh seed germinated very well, with 90% of the seed germinating with no stratification. They also found that some seed stored at room temperature for 6 months went into dormancy, which could be broken with stratification. Seed required exposure to sunlight and preferred warmer temperatures to germinate. Motley (1994) found that seed required moist to saturated substrate and full sun. Shipley and Parent (1991) obtain 91% germination after 30 days using 9 month old seeds from Ontario planted in pots filled with acid-washed sand and remaining 1 cm filled with a commercial potting soil.

Pre-treatment: No pre-treatment required for fresh seed and a four week cold stratification was used to break the dormancy of stored seed (Smreciu et al. 2012). None required (Bush 2001). Placed in porous nylon bags and buried in wet sand for 9 months of cold stratification (4°C) (Shipley and Parent 1991).

Direct Seeding: Germinates in less than 2 weeks with

***Acorus americanus* spadex and spathe (flowering florescence and bract).**

direct seeding (Bush 2001).

Vegetative Propagation: In an experiment performed by Smreciu et al. (2012) rhizome cuttings with some roots and leaves still attached had 100% survival rates. They also found that rhizome pieces with roots had good to fair survival and cuttings without roots or shoots did not survive. Plants can be propagated by division, specifically of the rhizome. There was a 38% survival of non-leafy rhizome cuttings the first year and 23% survival after 3 years; a 71% survival of leafy rhizomes the first year and 37% survival after 3 years in northeastern Alberta oil sands tailings pond.

Rhizome cutting of *Acorus americanus* with attached leaves and roots.

Aboriginal/Food Uses

Food: Can be chewed directly after picking (Duke 1992, Kindscher 1987, Northern Bushcraft n.d.). Rhizome can be made tender by prolonged boiling (Northern Bushcraft n.d.).

Some authors suggest stimulation, others hallucination from overconsumption. Was chewed in lieu of tobacco in Depression years. Can be boiled with maple sap to prepare candied sweet flag (Duke 1992). Young tender leaves can be added to salad (Kindscher 1987).

Medicinal: The bitter and aromatic rhizomes are highly valued as a multiple-usage medicine. Rhizome is chewed to treat colds and coughs, rheumatism, toothaches, headaches, muscle pain, and intestinal worms. Boiled rhizome may be used as an expectorant and to treat tonsillitis, sinus congestion, pneumonia, diabetes, high blood pressure or menstrual cramps. Also used as an antibiotic and insecticide (Marles et al. 2000).

Other: Calamus ascribed mystic powers and leaves used to make ceremonial garlands (Kindscher 1987).

Wildlife/Forage Usage

Wildlife: Rhizomes are eaten by muskrats and seeds are eaten by wood ducks. Waterfowl use sweet flag for habitat (Bush 2001).

Livestock: Little or no value for livestock.

Commercial Resources

Availability: Could be developed as an aqua-cultural product by modifying wild rice production methods (Marles et al. 2000).

Cultivars: None are known.

Uses: Essential oil for aromatherapy (Aromatherapies.net 2010).

Plant is an effective insect repellent (Northern Bushcraft n.d.).

Reclamation Potential

Studies are currently being done using *Acorus americanus* in the Athabasca oil sands region in wetlands reclamation. *Acorus americanus* is important in developing ecological diversity in

disturbed wetlands. As well, it is a culturally significant plant for the Aboriginal peoples in Northern Alberta (Smreciu et al. 2012).

Notes

Chromosome studies have shown that *Acorus calamus* plants are tetraploid and fertile in Asia, triploid and sterile in Europe, and mostly diploid and fertile in North America. Some authors believe that the North American diploids should be recognized as a distinct species, *Acorus americanus* (Rafinesque) Rafinesque. As for the eastern North American triploid populations, they are believed to have been introduced by early European settlers (Motley 1994, Packer and Ringius 1984). It is possible that there was intentional propagation of *Acorus* in some locations by Aboriginal people (Marles et al. 2000). *Acorus calamus* can survive long periods of anoxia (oxygen deprivation (Joly and Brandle 1995)).

Photo Credits

Photos 1 to 3: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, with permission from Bruce Peel Special Collection, University of Alberta.

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Scientific Name: *Actaea rubra* (Aiton) Willd. **Family:** *Ranunculaceae*

Common Names: baneberry

Plant Description

Dimorphic, perennial, 0.3 m to 1 m tall; from fleshy rhizomes; hairless, 1 to several stems; leaves, alternate, few, from the stem, 2 to 10 cm long, 2 to 3 times divided in 3; segments coarsely sharped toothed and lobed; many flowers, rounded clusters on long stalks, white sepals and petals 2 to 3.5 mm long (Johnson et al. 1995).
Petal number and stamen number vary between flowers (Lehmann and Sattler 1994).
Fruit: Glossy red or white (not both) ovoid berries containing several seeds; 6 to 8 mm long and poisonous (Johnson et al. 1995).
Seed: Brown half-moon shaped seed 3 to 4 mm long.

Habitat and Distribution

Moist woods, thickets, meadows and stream banks (Moss 1983).
Seral Stage: Mid to late seral.
Soil: Cool moist nutrient, rich sites (Crane 1990).
Distribution: Alaska, Yukon and western District of Mackenzie to Hudson Bay, Newfoundland south to California, Arizona, New Mexico, South Dakota, Ohio, New Jersey (Moss 1983).

Phenology

Flowering May to July and fruits persist from August to October across their range (Crane 1990).

Pollination

Wind and small insect pollination (Pellmyr 1985).

Seed Dispersal

By birds (Willson 1983).

Genetics

2n=16 (Moss 1983).

Symbiosis

Brundrett and Kendrick (1988) found that up to 80% of *A. rubra* roots were colonized by vesicular-arbuscular mycorrhizae.

***Actaea rubra* flowers from May to July across their range.**

Seed Processing

Collection: Collect ripe seeds into buckets or plastic bags. Keep seeds cool until they can be processed. Wear gloves and/or wash hands as berries are poisonous (Droppo 1987, Turner 1997).
Seed Weight: 5.7 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: Late July. When berries are no longer green but either red or white.
Cleaning: Macerate fruit in water and decant.
Storage Behaviour: Not tested but possibly orthodox (Royal Botanic Gardens Kew 2008).
Storage: Orthodox, seed can be dried and stored frozen (Royal Botanic Gardens Kew 2008).
Longevity: Unknown.

Propagation

Natural Regeneration: Spread by rhizomes (Johnson et al. 1995).

Germination: Takes 2 years to germinate (Crane 1990). Germination occurred 243 days after sowing and only 8.8% of the seed germinated (Crane 1990).

Pre-treatment: Stratify 4 weeks in warm conditions and 6 weeks cold (Crane 1990).

112 days stratification was done at 22/17ºC (Baskin and Baskin 2002).

Sow at 18 to 22ºC for 2 to 4 weeks, move to -4 to 4ºC for 4 to 6 weeks, move to 5 to 12ºC for germination (Clothier 2012).

Planting Density: No literature found.

Seed Rate: No literature found.

Vegetative Propagation: No literature found.

***Actaea rubra* seeds 3 to 4 mm long**

Aboriginal/Food Uses

Food: Is poisonous (especially for children – Droppo 1987) and can cause death; ingesting this plant is not recommended (Johnson et al. 1995). The toxicity of baneberry is attributed to an essential oil which produces symptoms of severe gastro-enteritis (Turner 1997).

Medicinal: Native Americans used the roots to treat coughs and colds, sores, hemorrhages, stomachaches, syphilis, and emaciation; preparations from the entire plant as a purgative; and infusions from the stems to increase milk flow (eFloras n.d.).

Other: Used in various Native American ceremonies (eFloras n.d.).

Ripe *Actaea rubra* berries, shown in its two colour variations white and red.

Wildlife/Forage Usage

Wildlife: Is consumed by several bird species (Crane 1990).

Livestock: Not consumed unless there is no other palatable forage available and can be deadly to livestock. Poor to fair forage (Crane 1990).

Grazing Response: Increaser (Tannas 2004).

Reclamation Potential

Low to moderate value for erosion control and revegetation potential and provide moderate biomass to a disturbed area. Easily grown from seed (Crane1990).

Notes

Actaea rubra is listed as 83% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Anneli Salo @ Wikimedia Common 2010.

Photo 2: Hardyplants @ English Wikipedia 2012.

Photo 3: Walter Siegmund @ Wikimedia Commons 2012.

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Scientific Name: *Anemone canadensis* L. **Family:** *Ranunculaceae*

Common names: Canada anemone, meadow anemone

Plant Description

Tufted perennial herb from short, slender rhizome, 20 to 50 cm tall; stems erect, hairy; leaves basal, 1 to 5, simple, ascending, long-petioled, strongly veined, circular in outline, 4 to 10 cm long, 5 to 15 cm wide, deeply palmate in 3 to 5 divisions, the divisions mostly 3-cleft, the ultimate segments 10 to 30 (35) mm wide, toothed and incised on the upper 1/3 to 1/2, tips pointed, lightly fine-hairy; stalks 8 to 22 (37) cm long; single white erect flower per plant with 5 sepals, petals absent (Klinkenberg 2013, Moss 1983).

Fruit/Seed: Achenes, obovoid to ellipsoid, winged, strigose to glabrate; beak straight, 2 to 6 mm, strigose, not plumose; borne in a globose head (Moss 1983).

Habitat

Damp thickets, meadows, wet prairies, lakeshores and stream sides (eFloras.org n.d., Moss 1983). Plants do best in areas that are full sun to part shade (Plants for a Future n.d.).

Seral Stage: Said to be late successional in Minnesota but can be an aggressive colonizer in optimal conditions, has been called a weed in domestic gardens (Jacobson 2006, Lady Bird Johnson Wildflower Center 2012).

Soils: Found in medium to wet, sandy loam to clay loam soils with a pH ranging from 6.8 to 7.2 (Prairie Originals n.d.).

Distribution: Throughout Alberta; southwest District of Mackenzie to Hudson Bay, Nova Scotia south to British Columbia, New Mexico, Missouri, Ohio, New Jersey (Moss 1983).

Phenology

First leaves are out mid-May. Flowers May through July (Plants for a Future n.d.). Seed ripen by the end of July.

***Anemone canadensis* seed collected at the end of July.**

Pollination

Insect pollinated by bees and flies (Plants for a Future n.d.). Flowers are self-incompatible producing little or no fruit when compared with pollination by an unrelated plant (Douglas and Cruden 1994).

Genetics

2n=14 (Moss 1983).

Seed Processing

Collection: Harvest by hand when seed is ripe, snip heads into breathable bags.

Seed Weight: 1.75 g/1,000 seeds (Wild Rose Consulting, Inc. 2009).
Harvest Dates: Late July (Wild Rose Consulting, Inc. 2009).
Cleaning: Crush to separate seed (Wild Rose Consulting, Inc. 2009).
Storage: Orthodox behaviour. Store dry in hermetically sealed containers at freezing temperatures (Royal Botanic Gardens Kew 2008).
Longevity: Unknown.

Propagation

Natural Regeneration: Spreads by seed and rhizome.
Germination: The seed usually germinates in 1 to 6 months at 15°C (Plants for a Future n.d.) but may take two years to germinate (Prairie Moon Nursery n.d.). 80% germination was achieved on a 1% agar media at temperatures of 20°C (8 hour day/18 night) with pre-treatments (Royal Botanic Gardens Kew 2008).
Pre-treatment: The seed is first mixed in equal parts of moist sand and vermiculite, and then cold stratified followed by a warm stratification and a second cold stratification (Prairie Moon Nursery n.d.). Pyle (2008) recommends cold stratification between 3 to 5°C for a period of 4 to 6 weeks followed by warm stratification between 18 to 24°C for a period of 2 to 4 weeks. Royal Botanic Gardens Kew (2008) used 4 weeks warm stratification at 20°C followed by a 12 week cold stratification at 5°C.
Direct Seed: Sow freshly ripened seed in a cold frame. Surface sow or only just cover the seed and keep the soil moist. Sow stored seed as soon as possible in late winter or early spring. When large enough to handle, pick the seedlings out into individual pots and grow them in light shade in the greenhouse for at least their first year. When the plants are large enough, plant them out in the spring (Plants for a Future n.d.).
Vegetative Propagation: May be propagated by cuttings taken in the spring or by division in the early spring or fall. The rhizome on each new plant should be several inches long and be planted to a depth of half an inch (Ladybird Johnson Wildflower Center 2012). Individual plants do not transplant well according to the Fletcher Wildlife Garden (2013).

Aboriginal/Food Uses

The roots and leaves are astringent (Plants for a Future n.d.). A decoction of the root was used to treat worms and pain in the lumbar region (Plants for a Future n.d.). An infusion of the root was used as an eye wash to treat crossed eyes, twitches and eye poisoning (Plants for a Future n.d.). A wash of the pounded boiled root or leaves was applied externally to wounds, nosebleeds, sores, etc. (Plants for a Future n.d., Royer and Dickinson 1996). The root contains protoanemonin, which is said to be a potent antiseptic (Plants for a Future n.d.). A tea of the roots was used in the treatment of headaches and dizziness (Plants for a Future n.d.).
Anemones contain caustic irritants which can be harmful – do not consume and handle carefully (Royer and Dickinson 1996). Poisonous if consumed in large quantities (Klinkenberg 2013).

Wildlife/Forage Uses

Not used by domestic animal or wildlife due to its toxicity (Mackinnon et al. 2009).

***Anemone canadensis* in flower.**

Reclamation Potential

Used in wetland and moist areas for reclamation (Jacobson 2006). This plant spreads by rhizomes which can be aggressive; this would be excellent for erosion control.

Commercial Resources

Availability: Seed and plants are commercially available in Alberta for landscaping (ANPC 2010).

Photo Credit

Photo 1: Courtesy of Walter Muma @ Ontariowildflowers.com.
Photo 2: Wild Rose Consulting, Inc.

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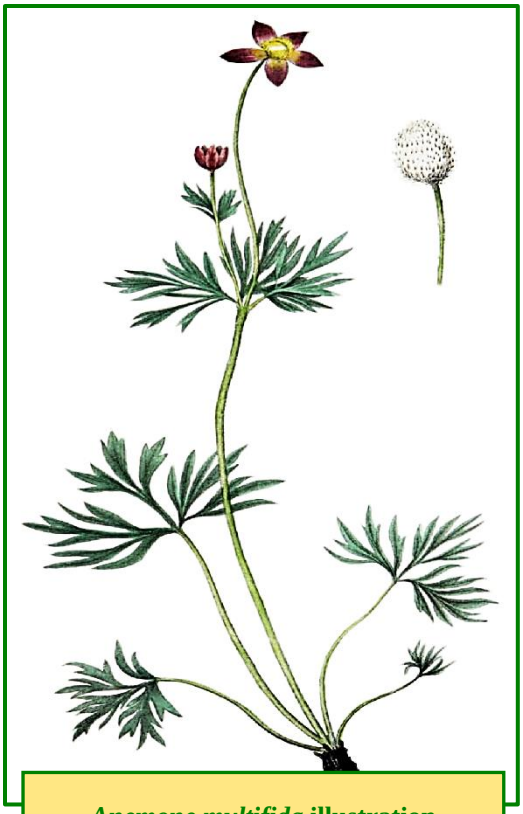
Scientific name: *Anemone multifida* Poir. **Family:** *Ranunculaceae*

Common Names: cut-leaf anemone, globe anemone



***Anemone multifida* illustration showing the blooming flower and the seed head**

Plant Description

Erect, herbaceous perennial from a branching taproot; 5 to 15 cm tall with basal and cauline leaves; basal leaves long-petioled, 3 to 7 cm wide, dark green, silky villose, deeply 3-parted, into linear oblong divisions; stem leaves three, sessile or sub-sessile, sub-tending the flowers; stem silky-pubescent from a stout caudex; flowers 1 to 4, 10 to 20 mm diameter, sepals white, creamy or deep pink (Moss 1983).

Fruit: A globose or ovoid head (1 cm wide) of woolly achenes.

Seed: Achene 2 to 3 mm long, surface brown covered in dense wooly hair.

Habitat and Distribution

This species grows in mesic to dry open woodlands and dry to mesic prairie grasslands.

Seral Stage: Early seral species (Tannas 2004).

Soils: Slatey or calcareous gravels, sandy and lighter soils (Currah et al. 1983). Has no salinity tolerance and a low tolerance to drought (USDA NCRS n.d.). In soil pH range of 6 to 7.5 preferred (USDA NCRS n.d.).

***Anemone multifida* in flower.**

Colour variation in *Anemone multifida* flowers.

Distribution: Common on dry grasslands, open dry woodlands in the parkland, boreal, montane and sub-alpine regions of Alberta. Alaska, Yukon, southwest District of Mackenzie to Hudson Bay, Newfoundland south to California, Nevada, New Mexico, Minnesota, Maine (Moss 1983).

Phenology

Emerges in early May, flowers late May and June. Seed ripens in July or August. Plants die back in September.

Pollination

Insect pollinated (CYSIP: Botany 2012).

Seed Dispersal

Anemone sp. are dispersed by ants (Baskin and Baskin 2001).

Genetics

2n=32 (Moss 1983).

Symbiosis

Associated with vesicular–arbuscular mycorrhiza (Currah and Van Dyk 1986).

Seed Processing

Collection: Harvest by hand when seed is ripe, snip stems or pull off heads.
Seed Weight: 600 seeds/g (Gerling et al. 1996).
Harvest Dates: Late July to early August.
Cleaning: Seed hairs are difficult to remove from the achene; best to rub seeds on a corrugated rubber surface. Clean with hammermill (Luna et al. 2008).
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, usually much lower than they would normally achieve in nature; their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).

***Anemone multifida* achene with pappus (left) and fully cleaned (right). Achenes 2 to 3 mm long.**

Storage: Store dry at cool temperatures. drying seed to low moisture content (3% to 7% fresh weight, depending on the species) and store them in hermetically-sealed containers at low temperature, preferably at -18ºC or cooler (Fassil and Engels 1997).
Longevity: Seed viable for five years (Luna et al. 2008). Oldest collection is 18 years old, average age is 15 years with germination 91% to 100% (Royal Botanic Gardens Kew 2008).

Propagation

Germination: Not all seed lots are dormant, however, Smreciu et al. (1988) observed 74% to 92% germination with stratified seeds. 100% germination was observed at the Royal Botanic Gardens Kew (2008) on a 1% agar media in temperatures 15 to 26°C with varying light dark treatments.
Pre-treatment: One month cold stratification (Smreciu et al. 1988); seeds should be rinsed for 24 hours prior to a four month cold stratification (Luna et al. 2008).
Vegetative Propagation: By division of mature plants in spring. Rhizomatous reproduction (Wisconsin DNR 2013).

Aboriginal/Food Uses

Food: All parts are poisonous when fresh. Toxic if eaten in large quantities (Lady Bird Johnson Wildflower Center 2012).

Wildlife/Forage Usage

Wildlife: Fair forage value for wildlife (Gerling et al. 1996). It is common to see the flower heads browsed down.
Livestock: Poor forage value for livestock because it is somewhat toxic (Gerling et al. 1996, Tannas 2004).
Grazing Response: Increases with grazing (Tannas 2004).

Reclamation Potential

Although this species does not cover large areas in natural situations it is a significant component of drier habitats and contributes to increased diversity.

Commercial Resources

Availability: Seed and plants are commercially available in Alberta (ANPC 2010).
Cultivars: Are available including; 'Annabella', 'Major' (Benary n.d., Perennials.com n.d.), however these should not be used in reclamation.
Uses: *Anemone multifida* is occasionally grown as an ornamental.

Notes

Plants of this species are slightly poisonous due to the presence of protoanemonin in the foliage (Tannas 2004).

Photo Credits

Photo 1: Glen Lee, Regina, Saskatchewan.
Photo 2: Arden Nering, Wild About Flowers, Turner Valley, Alberta.
Photo 3: Wild Rose Consulting, Inc.
Illustration: John Torrey, M.D., F.L.S. @ Wikimedia commons 2012

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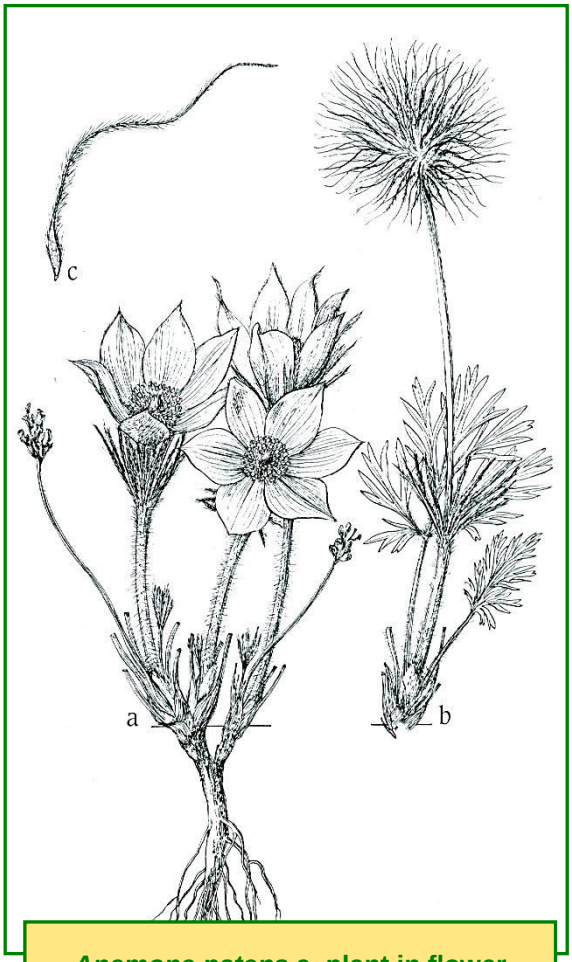
Scientific Name: *Anemone patens* L. **Family:** *Ranunculaceae*

Common Names: prairie crocus, crocus anemone, pasqueflower



Anemone patens **a. plant in flower prior to leaves expanding b. seed head with expanded leaves c. single seed (achene) with awn.**

Plant Description

Long lived perennial forb, 10 to 40 cm high with a tap root, vertical and branched rhizomes, silky hairs throughout; long stalked basal leaves appear after emergence of flowers, three times divided, the middle segment three-cleft and the lateral two-cleft, divisions further cleft into linear or lanceolate acute lobes; involucral leaves similar but sessile; solitary flowers with pale blue to purple sepals 2 to 4 cm long, hairy on the back, no petals (Moss 1983).

Fruit: One seeded achenes born on heads (Moss 1983).

Seed: Linear-ellipsoid, 3 mm long with persistent slender styles, short-plumose, 2 to 3.5 mm long (Moss 1983).

Habitat and Distribution

Found on prairies, hillsides, dry woods, edges of gravel pits, roadsides, clearcut areas, in fescue grassland, in open grasslands and in dry open woods in montane and boreal areas. Seedling establishment and flowering is enhanced by microhabitat variation (Kalliovirta et al. 2006).

Soil: Well-drained sandy soils.

Seral Stage: Mid to late.

Distribution: Found across Alberta, north to Arctic coast and Banks Island, Northwest Territories. Alaska, Yukon, western District of Mackenzie, northern Saskatchewan, southwestern Manitoba, western Ontario south to Washington, Montana, New Mexico, Texas, Missouri, Illinois (Moss 1983).

Anemone patens **growing in its natural habitat.**

Phenology

Flowers from April to June with leaves emerging late May and early June. Vegetative growth occurs in July. Seeds are dispersed beginning in June through the beginning of July. Seeds germinate late summer or following spring (Kalamees et al. 2005). Blooming date has advanced by two weeks since 1936 due to climate change; increasing the species susceptibility to frost damage (Beaubien and Hamann 2011).

***Anemone patens* plant in flower (leaves open following flowering).**

Pollination

Cross-pollinated by honeybees, andrenid bees, bumblebees and syrphid flies. Self-pollinates as well (Werner 1974).

Seed Dispersal

Animal and wind dispersed, using awn either to ride breezes or catch on passing animals.

Genetics

2n=16 (Moss 1983).

Symbiosis

Anemone patens roots are colonized by symbiotic arbuscular mycorrhizal fungi which significantly improves seedling establishment by increasing phosphorus content in plant tissues (Moora et al. 2004).

Achenes of *Anemone patens* with awn (left) and without awn (right) 2 to 3.5 mm long.

Seed Processing

Collection: Harvest by hand in early June. Remove seeds by hand, de-awning not required. Store dry in cool temperatures.

Seed Weight: 1.530 g/1,000 seeds.

1.96 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Harvest Dates: Late spring to early summer.

Cleaning: De-awn if desired. Seed is usually removed clean.

Storage Behaviour: Orthodox. Seed should be dried to low relative humidity and stored at freezing temperatures (Royal Botanic Gardens Kew 2008).

Storage: Maintain in hermetically sealed containers at freezing temperatures (Royal Botanic Gardens Kew 2008).

Longevity: Seeds are relatively short lived (Kalamees et al. 2005).

Propagation

Natural Regeneration: Seeds germinate readily and do not form a persistent seed bank (Williams and Crone 2006).

There is also branching of the vertical root system that might allow vegetative reproduction. Pasqueflower possibly produces new rosettes near the parent plant from underground rhizome (Kalliovirta et al. 2006).

Germination: No pre-treatment required. 50% to 65% germination for seeds collected in northeastern Alberta. Optimal germination temperature was found to be 18-21°C (Baskin and Baskin 2001).

Pre-treatment: Cold stratification for 60 days (Baskin and Baskin 2001).

Direct Seeding: A trial was initiated in 2008 on a reclaimed site in north-eastern Alberta. No data are as yet available.

Vegetative Propagation: 2 to 4 cm long root cuttings placed in a well-drained medium with bottom heat will initiate roots and shoots in 28 to 35 days (Currah et al. 1983).

Greenhouse Production: Best seeded as soon as seed ripens in early summer in a cold-frame for nursery production. Stored seeds can be sown in late winter. Allow 1 to 6 months for emergence. Transfer seedlings to individual pots and grow in greenhouse for one winter season. Transplant to final location in the spring (Plants for a Future, n.d.).

Aboriginal/Food Uses

Food: Poisonous if taken internally (causes vomiting, purging, tremors and collapse) (Marles et al. 2000).

Medicinal: A poultice of crushed leaves was applied externally to relieve rheumatism as a counter-irritant (Marles et al. 2000, Royer and Dickinson 1996).

Other: Called the *ears of the earth* because it seems to spring through the snow to listen for the approach of summer (Royer and Dickinson 1996). Sepals used by early settlers to make a dye for Easter eggs (Royer and Dickinson 1996).

Wildlife/Forage Usage

Wildlife: Poor forage value, low palatability, mildly toxic species due to its protoanemonin content (Tannas 2004).

Livestock: The hairs on this plant may cause irritation and impairment of the gastrointestinal tract of sheep (Budd and Best 1969, Tannas 2004).

Grazing Response: An increaser; pasqueflower has a reserve of viable dormant buds enabling the plant to initiate new branches (Kalamees et al. 2005). Dense stands of prairie crocus are often an indicator of overgrazing in pastures (Budd and Best 1969, Tannas 2004).

Reclamation Potential

Anemone patens is a valuable reclamation species. It is well adapted to disturbed habitats. Forest fires enhance the conditions for seed germination and seedling development by reducing moss and litter layer thickness and decreasing competition pressure (Kalamees et al. 2005).

Anemone patens has been successfully re-established on calcareous grassland which had seen the topsoil removed; was most successful when in conjunction with hay transfer (Kiehl and Röder 2008).

Commercial Resources

Availability: Seeds occasionally available in Alberta.

Cultivars: Some horticultural cultivars are available but are not suitable for revegetation.

Uses: Ornamental garden species.

Notes

Anemone patens is now considered endangered in Finland and is included in several national Red Lists. This is due to the closure of undergrowth vegetation caused by the cessation of cattle grazing in forests, fertilization of managed forests, planting of trees and efficient fire prevention (Kalliovirta et al. 2006).

According to research models, survival and population growth rates of *Anemone patens* were greatly reduced when growing among invasive grasses (i.e., *Bromus sp.*) compared to native grasses due to

the build-up of a heavy thatch layer (Williams and Crone 2006).
Formerly known as *Pulsatilla patens* (IT IS n.d.).

Photo Credits

Photos 1 and 2: Glen Lee, Regina, Saskatchewan.
Photo 3: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific name: *Apocynum androsaemifolium* L.

Family: *Apocynaceae*

Common Names: spreading dogbane, bitterroot, flytrap, Indian hemp

Plant Description

Erect perennial herb, 20 to 100 cm high; well branched stems above; rhizomes up to 25 cm deep that can form extensive colonies; opposite, ovate to oblong, simple, mucronate leaves 2.5 to 8 cm long; short-petioled; fragrant, pink, bell-shaped flowers in loose, terminal, panicled cymes hanging from stem tips and leaf axils, petals 6 to 9 mm long (Moss 1983).

Stems when broken exude a milky sap (Budd and best 1969).

***Apocynum androsaemifolium* in flower.**

Fruit: 8 to 12 cm long follicles and 5 mm thick, paired pods that split along one side to release the seeds (Moss 1983).

Seed: Numerous 2.5 to 3 mm long seeds each with long (1 to 2 cm) off-white tuft of hairs at tip.

Habitat and Distribution

Shade tolerant. Common in sandy areas on well drained, open sites in woods, roadsides, open hillsides and ridges. Can also be found in riparian zones, moist areas with clayey soil (Hardy BBT 1989).

Seral Stage: It is a mid-seral species in multiple habitat types (Groen 2005).

Soils: Found on fine to medium soil textures and dry soils (Gerling et al. 1996). Found in soils with pH ranging from 5.0 to 7.7 (Groen 2005).

Distribution: Widespread across Alberta, north and west to Great Slave Lake and interior Alaska. Alaska, Yukon, southwestern District of Mackenzie to James Bay, southern Quebec, Newfoundland south to California, Arizona, Texas, Georgia (Moss 1983).

Phenology

Flowers bloom in June and July. Seeds are ripe in late summer (September) (Shultz et al. 2001).

Pollination

Spreading dogbane is insect pollinated (Bergweiller and Manning 1999) by bumble bees (*Bombus terricola* and *B. ternaries*) (Marden 1984). It is also self-pollinated (Groen 2005).

Genetics

2n=16

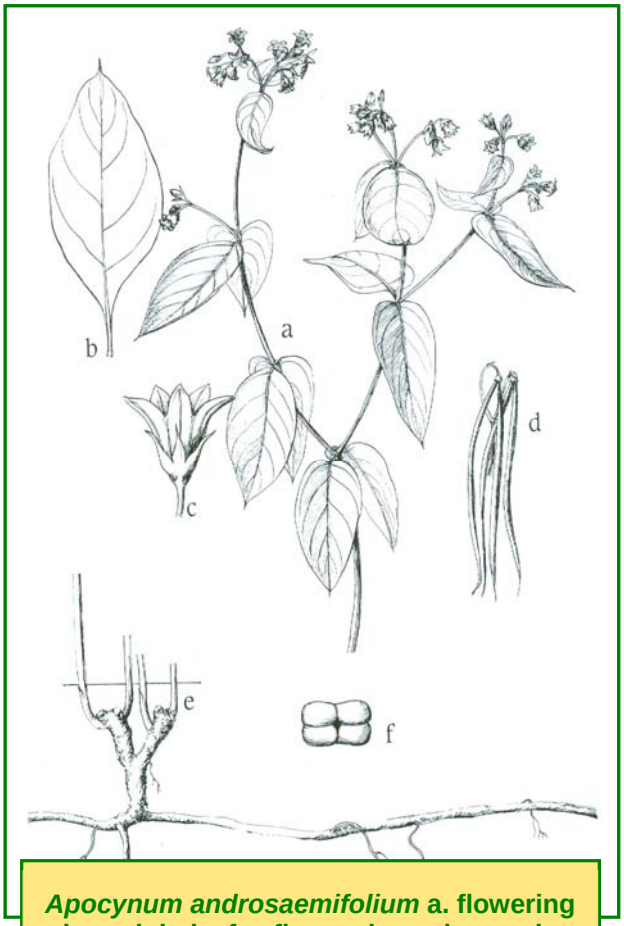
Symbiosis

Vesicular-arbuscular mycorrhizae were observed by Currah and Van Dyk (1986).

Seed Processing

Collection: Collect whole capsules when rusty.
Seed Weight: 0.1459 g/1,000 seeds.
Harvest Dates: Mid to late August.
Cleaning: Pull seeds from seed heads by hand. Rub seeds with pappus between corrugated rubber in a box. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing.
Alternatively, pappus with attached seeds can be placed on a sieve with mesh size large enough to let seeds through and stacked on a sieve that will catch the seeds. Place a smaller sieve over the top sieve and direct a strong flow of air (such as that produced by a reversed vacuum) through the top sieve. Seeds will be removed from the pappus and lodge in the small mesh sieve.
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).

Seeds of spreading dogbane. Seeds 2.5 to 3 mm long.



***Apocynum androsaemifolium* a. flowering branch b. leaf c. flower d. seed capsule e. rhizome and roots f. pollen tetrad.**

Storage: Store cold for up to three years (Schultz et al. 2001). No loss in viability in when stored in the open at room temperature after three years (Royal Botanic Gardens Kew 2008).
Longevity: Dried seeds kept in storage germinated after 5 years (Groen 2005).

Propagation

Natural Regeneration: Prolific underground rhizomes (Bergweiler and Manning 1999) and seeds (Gerling et al. 1996).
Germination: In their germination requirements study, Drake and Ewing (1997) report 2% germination after 30 days with no stratification with three to six months old seeds. Over 90% of fresh seeds collected in northeastern Alberta germinated with no stratification.

Pre-treatment: In their propagation notes, Hudson and Carlson (1998) suggest soaking the seed for a period of 24 hours followed by 2 months stratification in a mesh bag between layers of peat at 2°C. Seed sowing should occur on May 1 in 100% peat at 24°C day/20°C night germination temperatures and 18 to 20°C growing temperatures. Adding 30 to 50 ppm N one to two times every week will help encourage healthy growth.
Direct Seeding: Seeds can be sown as soon as they are ripe (late summer) and over-wintered outdoors (Plants for a Future n.d.).
Vegetative Propagation: Division can be made either in the spring, just before active growth begins, or in the autumn (Plants for a Future n.d.).

Aboriginal/Food Uses

Food: No known food uses (Plants for a Future n.d.). Can be mildly to severely toxic with internal and external symptoms (Hamel and Chiltoskey 1975).
Medicinal: The roots can be used as a cardiac stimulant and diuretic, for kidney ailments, asthma, arthritis, rheumatism, constipation, fever, to cure insomnia, and infusions to expel pinworms and threadworms and to prevent falling hair (Tannas 1997). By boiling the whole plant, a medicinal tea was made to increase lactation in nursing mothers (alternatively a decoction was applied directly to breasts – Royer and Dickinson 1996) and was also used, once cooled, as an eyewash to treat sore eyes.
Other: The tough, fibrous bark was used to make twine, fishing nets and thread (Marles et al. 2000). Cherokee used as a treatment for mange (Hamel and Chiltoskey 1975).

Wildlife/Forage Usage

Wildlife: Eaten by ground squirrels; intermittently grazed by elk; used by bees for honey production; used as nest building sites by crab spiders and provides canopy cover (Groen 2005).
Livestock: Poor forage value, unpalatable, contains bitter, toxic steroid glycosides that discourage browsing (considered mildly toxic when consumed in large quantities). Sheep occasionally browse it (Tannas 1997).
Grazing Response: Spreading dogbane is an increaser (Gerling et al. 1996).

Reclamation Potential

Has potential in reclamation because of the rhizomes' effective soil stabilization properties, especially useful on exposed slopes (Tannas 1997).
Can sprout immediately on recently burned soil through rhizomes (Groen 2005).
Releases large numbers of wind-dispersed seeds (Bergweiler and Manning 1999).
Prospers after disturbances such as fire and clear cuts (Rook 2004).
Can be successfully transplanted, although change in elevation may cause a change in their development timeline (Groen 2005).
Has been found to successfully spread from topsoil islands to tailings (Winterhalder 2004).
Cunningham (1994) has declared the use of this plant for accumulation of lead from contaminated soils.

Commercial Resources

Availability: Not commercially available in Alberta (ANPC 2010).
Uses: Incisions on the stem yield latex, a possible source of rubber (Royer and Dickinson 1996). Spreading dogbane is an ornamental plant but can be invasive (Plants for a Future n.d.).

Notes

Apocynum androsaemifolium is listed as 72% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Spreading dogbane has been recognized as a native bioindicator for ozone (Bergweiler and Manning 1999).
This species was considered a noxious weed in Alberta due to its toxic effects on livestock (Government of Alberta 2008), but has never been recorded as invasive in revegetation usage.

Photo Credits

Photo 1: Glen Lee, Regina, Saskatchewan.
Photo 2: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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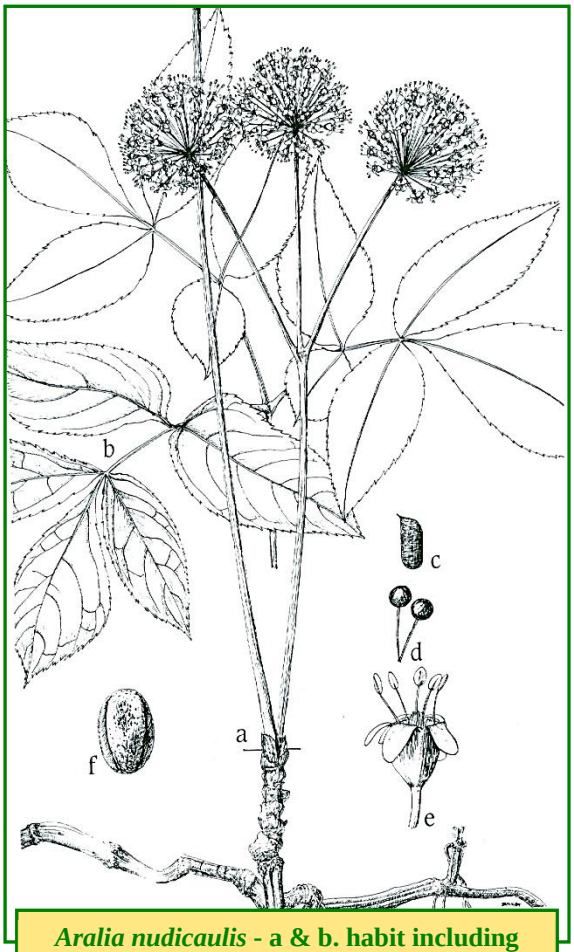
Scientific Name: *Aralia nudicaulis* L. **Family:** *Araliaceae*

Common Name: wild sarsaparilla



***Aralia nudicaulis* - a & b. habit including inflorescence, leaves and roots. c. seed d. fruit e. flower f. pollen**

Plant Description

Erect, dioecious (Barrett and Thompson 1982; Bawa et al. 1982), perennial, rhizomatous forb, often growing in patchy clonal colonies with two types of shoots, vegetative and reproductive (Edwards 1984); leaf long stalked, 30 to 60 cm high, twice compound, being ternate and each division pinnate (3 to 5 foliate); leaflets ovate-oblong to elliptic-lancolate (Moss 1983); pale green to white epigynous flowers generally in three ball-like clusters 2 to 5 cm across; female flowers with five styles and five non-functional anthers; male flowers with five long stamens with white anthers and five non-functional styles (Flanagan and Bain 1988). Plants are effectively dioecious.

Fruit: Berry-like fruit, blue-black when mature, globose; borne in globose clusters (Rook 2004).

Seed: Flat, brown to brown-black, oblong. Two of the five seeds ripen on average (Flanagan and Bain 1988).

Habitat and Distribution

Widespread and major understory native species in dry to moist aspen and mixedwood forests (Rook 2004) at latitudes higher than 60° N to lower than 40° N in many climatic regions (Flanagan and Bain 1988). Aggregated plants may be from different rhizome systems, and connected ramets are widely

***Aralia nudicaulis*, perennial rhizomatous forb, often growing in patchy colonies**

dispersed over many patches (Edwards 1984). Shade tolerant, minimum root depth of 25 cm (USDA NRCS n.d.).

Soil: Found on a range of soils from fine loamy clay to coarse loam, moderate to rich in nutrients, poorly to well drained. *A. nudicaulis* grows best in sandy soils with pH of 5 to 6 (Rook 2004). It is common on well drained Luvisols, Brunisols and Podzols (Flanagan and Bain 1988). Has no salinity tolerance, moderate drought tolerance (USDA NRCS n.d.).

***Aralia nudicaulis* berries**

Distribution: Widespread in all Canadian provinces and territories (except for Nunavut) and east to Georgia, west to Colorado (Flanagan and Bain 1988, USDA NRCS n.d.).

Southwestern District of Mackenzie, British Columbia to Newfoundland south to Washington, Montana, Colorado, Nebraska, Missouri, Georgia (Moss 1983).

Pollination

Female ramets flower before males. Pollinated primarily by bumble bees (*Bombus vagans* and *Bombus ternarius*) and possibly other insects found on flowers during pollination (Flanagan and Moser 1985).

Seed Dispersal

Birds and bears (Pavek 1993).

Genetics

Primarily 2n=24 (Flanagan and Bain 1988).
2n=48 (Moss 1983).

Phenology

Leaves and flowering stalks emerge concurrently in May and early June. Plants flower in June with fruit and seed ripening late in July or August (Flanagan and Bain 1988). Fruits mature in approximately 32 days after pollination (Helenurm and Barrett 1987).

Symbiosis

Vesicular-arbuscular mycorrhizae (Currah and Van Dyk 1986). Unidentified endomycorrhizae associated with the roots (Flanagan and Bain 1988). Isolates of *Heteroconium chaetospira* have been obtained from roots of *A. nudicaulis* (Usuki and Narisawa 2007).

This species has been shown to influence soil microfungal species community (De Bellis et al. 2007).

Flowering *Aralia nudicaulis*

Seed Processing

Collection: Harvest by hand when fruit is ripe.
Seed Weight: 198 seeds/g (9 g/1,000 seeds) from northeastern Alberta accessions (Smreciu and Gould. 2010).
220,000 seeds/kg (4.5 g/1,000 seeds) in US (USDA NRCS n.d.).
Fruit Volume: Average 3,320 fruit/L (16,660 seeds/L of fruit) (Smreciu and Gould. 2010).
Fruit Weight: Average 5,650 fruit/kg (28,250 seeds/kg fruit) (Smreciu and Gould 2010).
Average Seeds/Fruit: 5 seeds/fruit. Often only two fully develop (Flanagan and Bain 1988).

***Aralia nudicaulis* seed. Each seed is approx. 4 mm long.**

Harvest Dates: Late July to mid-August (Helenurm and Barrett 1987).
Cleaning: Macerate fruit in blender on low speed and decant in several changes of water (Bonner and Karrfalt 2008). Allow to air dry. Sieve or winnow small chaff after drying (USDA NRCS n.d.).
Storage Behaviour: Uncertain (Royal Botanic Gardens Kew 2008).
Storage: Store dry in airtight containers at low temperatures (USDA NRCS n.d.). Dry hermetic storage recommended (Royal Botanic Gardens Kew 2008).
Longevity: Unknown.

Propagation

Natural Regeneration: Once established, *A. nudicaulis* spreads primarily by rhizomes forming large colonies. *A. nudicaulis* reproduces vegetatively from rhizomes as well as from seed.
Direct Seed: Sow as soon as ripe, germinates within 4 months (Plants for a Future n.d.).
60 to 70 day cold stratification required (Baskin and Baskin 2001).
Germination: Stratified seed has higher germination than unstratified seed (Rook 2004).
Seeds taken from black bear scat have been shown to have significantly higher germination rates than undigested seeds (Rogers and Applegate 1983).
Planting Density: 1,900 to 4,500 plants per hectare (USDA NRCS n.d.).
Vegetative Propagation: Root cuttings of 8 cm, can be taken in December and stored cold, in sand, until spring. Winter division is also successful (Plants for a Future n.d.).

Aboriginal/Food Uses

Food: *A. nudicaulis* is a member of the Ginseng family. Roots, although tasteless, can be chewed for energy, and the rhizomes were an original ingredient in root beer (Royer and Dickinson 1996, 2007). Droppo (1987) notes that while the root has some use as a substitute for true sarsaparilla it should not be confused with ginseng root.
Medicinal: Tea made from roots has been used to relieve children's infected gums, venereal disease, pneumonia, heart pain, and stomach and liver problems. Roots can be eaten fresh to treat chills, fevers and rheumatism (Royer and Dickinson 1996). Poultices of bark or roots can promote healing of wounds (MacKinnon et al. 2009). It has also been used to promote sweating and for cough relief (Brussell 2004) and may have anti-cancer effects (Wang et al. 2006). It has anti-microbial effects (Li et al. 2012).

Wildlife/Forage Usage

Wildlife: Berries are a food resource for black bears in aspen and boreal forest (Payne et al. 1998, Rogers

and Applegate 1983) and grizzly bears in west-central Alberta (Munro et al. 2006). The seeds have been found in the stomachs of thrushes (Edwards 1985).

A. nudicaulis has low palatability for browsing or grazing animals (USDA NRCS n.d.), although it is an important resource for moose, which eat the flowering and vegetative shoots in the spring.

Livestock: Poor forage generally considered to be of little significance as range plant (Tannas 2004).

Grazing Response: Increaser (Tannas 2004). Increased herbivory reduces the number of flowering stems and fruit production (Edwards 1985).

Reclamation Potential

A. nudicaulis population numbers to do not recover well post logging (Moola and Vasseur 2008).

A. nudicaulis decreases initially after disturbances such as fire and logging but surviving rhizomes will sprout and produce new rhizomes (Chapman and Crow 1981). Quintilio et al. (1991) showed multiple fires had little effect on percent of *A. nudicaulis*.

It is present at several successional stages from young to old forest communities, possibly due to rapid regeneration from rhizomes after disturbance or to some benefit from disturbance (e.g., wildfire, clear cut; Flanagan and Bain 1988).

Commercial Resources

Availability: Plants are commercially available in Alberta (ANPC 2010).

Uses: None known.

Notes

Aralia nudicaulis is listed as 81% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photos 1 and 2: Mary T. and Frank L. Hoffman Family Foundation.

Photo 3: Katy Chayka, El Summit Perennials Nursery.

Photo 4: Wild Rose Consulting, Inc. 2012.

Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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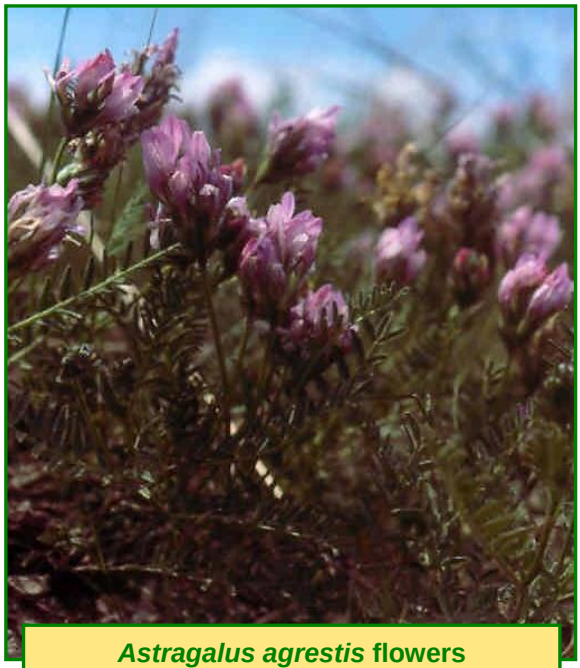
Scientific Name: *Astragalus agrestis* Dougl. ex G. Do
Family: *Fabaceae*

Common Names: cock's-head, field milkvetch, purple milkvetch



***Astragalus agrestis* flowers**

Plant Description

Rhizomatous perennial, forming mats, reclining to ascending 10 to 30 cm long; hairless to hairy branches with black and white hairs; leaves, alternate and pinnately compound; linear to oblong-lanceolate, notched leaflets 1 to 2 cm, silky hairs cover the leaves; raceme flower cluster, dense spherical heads 1 to 4 cm, erect-ascending, purplish or whitish flower (Tannas 1997).

Fruit: Pods, stalkless erect, egg shaped-oblong, 1cm, covered in black hairs (Tannas 1997).

Habitat and Distribution

Found in fescue grassland, moist or depressional grassland in the driest regions, in sandy soils, montane and alpine slopes and meadows (Tannas 1997).

Soil: Medium textured soil with a pH range 6.3 to 7.7. No tolerance to salinity (USDA NRCS Plants Materials Database 2011).

Distribution: Yukon, western District of Mackenzie to southern Hudson Bay south to California, New Mexico, Kansas, Iowa, Minnesota (Moss 1983).

Phenology

Summer bloom and growth period.

Pollination

Flowers are pollinated by bees and other insects.

Seed Dispersal

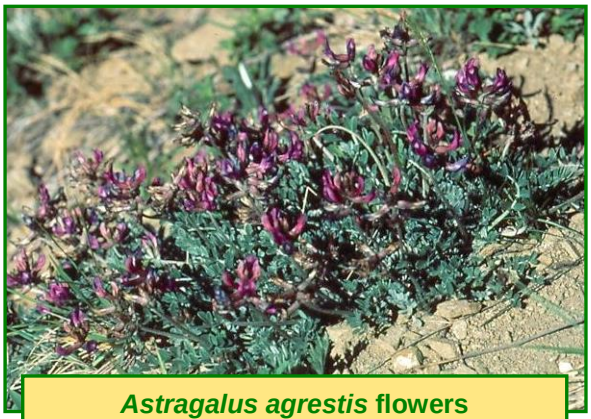
Seeds fall when pods dehisce.

Genetics

2n=16 (Moss 1983).

Symbiosis

Associated with nitrogen fixing bacteria.



***Astragalus agrestis* flowers**

Seed Processing

Collection: Collect seed head when flowers fade; allow drying (Dave's Garden n.d.).

Seed Weight: 260 seed/g or 3.84 g/1,000 seeds (USDA NRCS Plants Materials Database 2011).
Cleaning: Crush dried pods and winnow seed. Screen any remaining chaff.
Harvest Dates: Mid to late summer.
Storage Behaviour: Likely Orthodox.
Storage: Probable long term storage under IPGRI preferred conditions.
Longevity: No literature found.

Propagation

Natural Regeneration: Seed with slow to moderate spread rate. Mats spread out via rhizomes.
Germination: Many legumes benefit from scarification prior to germination.
Pre-treatment: Scarification.
Seeding Rate: Based on other *Astragalus* species, Pahl and Smreciu (1999) recommend a rate of 100 seeds/row m.

***Astragalus agrestis* seeds. Black line in picture is 5 mm**

Aboriginal/Food Uses

Food: Absorbs toxins such as selenium, making consumption undesirable.
Medicinal: No literature found.

Wildlife/Forage Usage

Wildlife/Livestock: Moderately palatable forage with high protein content (Tannas 1997). Can cause locoism due to toxic content absorbed.

Grazing Response: Increaser; does not survive in abused or altered range (Tannas 1997).

Reclamation Potential

As a nitrogen fixing species, *A. agrestis* could be beneficial in an early seed mix.

Notes

Synonym : *A. dasyglottis* Fisch ex DC. (ITIS n.d.).

Photo Credits

Photos 1&2: Wild Rose Consulting, Inc. 2011.
Photo 3: Tracey Slotta @ USDA-NRCS PLANTS Database.

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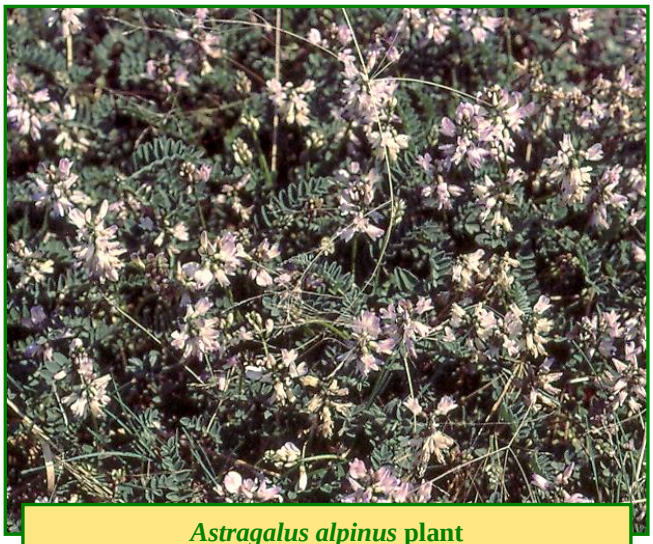
USDA NRCS, n.d. *Astragalus agrestis* Douglas ex G. Don purple milkvetch. IN: The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana. http://plants.usda.gov/core/profile?symbol=ASAG2 [Last accessed October 8, 2013].

Scientific Name: *Astragalus alpinus* L. **Family:** *Fabaceae*

Common Names: alpine milkvetch



***Astragalus alpinus* plant**

Plant Description

Low, mat forming perennial 5 to 30 cm tall with widespread rhizomes: stems leafy, spreading or ascending; leaves compound, 5 to 15 cm long; 11 to 25 leaflets, 5 to 20 mm, oval to oblong elliptic, rounded or shallowly notched at the tip; flowers, 5 to 17 in crowded, 1 to 4 cm long cluster at stem tip; sepals black-hairy; petals light bluish or pinkish purple to almost white, side petals often whitish 7 to 12 mm long (Johnson et al. 1995).
Fruit: Black-hairy pods about 1 cm, short stalked, bent downwards on stalk (Johnson et al. 1995).
Seed: Light to dark brown, kidney shaped, 2 to 3 mm long, smooth (Pahl and Smreciu 1999).

Habitat and Distribution

Forest edges, meadows, and open sandy or gravely places; widespread across boreal forest (Johnson et al. 1995).
Seral Stage: Early seral colonizer but can persist to climax communities on tundra (Anderson 2007).

Distribution: Circumpolar: Alaska, Prince Patrick Island to northern Baffin Island to Newfoundland south to Washington, northeast Oregon, northeast Nevada, New Mexico, Alberta, Saskatchewan, Manitoba, western Ontario, James Bay, Quebec (Moss 1983).

Phenology

Short lived, cool season perennials; flowers continuously from early June to September; seeds ripen from mid-June to late September.
Cultivated plants flower as early as the beginning of May and continue throughout the growing season (Pahl and Smreciu 1999). Cultivated stands can live 2 to 3 years (Pahl and Smreciu 1999).

Pollination

Insect pollinated. Self-incompatible and mainly pollinated by bumble bees at alpine sites and as elevations decrease, pollination by moths increases (Kudo and Molau 1999).

Seed Dispersal

Seeds are dispersed by wind (Royal Botanic Gardens Kew 2008) and water. Seeds can float from 3 to 13 days (Anderson 2007).

Genetics

2n=16, 32 (Moss 1983).

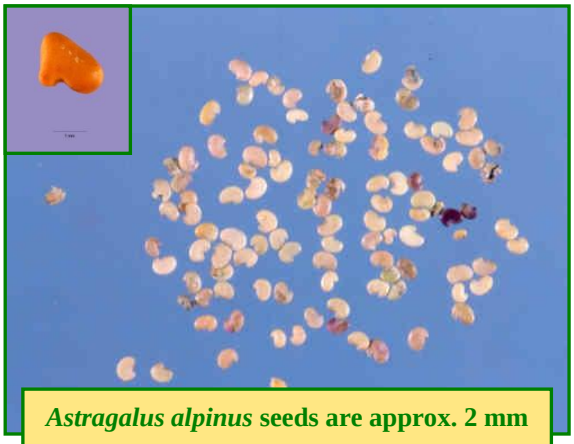
Symbiosis

Forms nodules with rhizobial bacteria to fix atmospheric nitrogen; associated with dematiaceous surface root fungi (Pahl and Smreciu 1999).

Seed Processing

Collection: In cultivation, expect the greatest seed yield in the second year of growth (Pahl and Smreciu 1999). Use a seed stripper or for smaller lots: cut,

bag, hang, or spread to dry and thresh (Pahl and Smreciu 1999).
Seed Weight: 476 to 588 seed/g or 1.7 to 2.1 g/1,000 seeds (Pahl and Smreciu 1999).
Harvest Dates: Early to mid-July (Pahl and Smreciu 1999).
Cleaning: Coarse screen to remove leafy material from harvested seed. Use a top screen 5 1/2 / 64" round and a bottom screen 6 x 26 mesh (Pahl and Smreciu 1999).
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store hermetically in sealed containers at freezing temperatures (Royal Botanic Gardens Kew 2008).
Longevity: No literature found.



***Astragalus alpinus* seeds are approx. 2 mm**

Propagation

Natural Regeneration: Emerges from seed; mats expand by rhizomes.
Germination: 95% to 100% in 3 to 10 days with pre-treatment (Pahl and Smreciu 1999).
Pre-treatment: Scarification (either scratch seed coat or immerse seeds for 5 to 7 minutes in concentrated sulphuric acid followed by 4 to 7 successive washes in water (Pahl and Smreciu 1999).
Direct Seeding: Seed at a depth of 0.6 cm. Seeding in mid-August or later may result in winterkill (Pahl and Smreciu 1999).
Seed Rate: 100 to 120 seeds/linear m of row (Pahl and Smreciu 1999).
Vegetative Propagation: Rhizome cuttings; divide mature plants (Pahl and Smreciu 1999).

Wildlife/Forage Usage

Wildlife: Caribou, arctic hares and greater snow geese graze *A. alpinus* and grizzly bears forage for underground parts (Anderson 2007).
Livestock: It is grazed by livestock though some members of the *Astragalus* genus are poisonous (Anderson 2007).
Grazing Response: Increaser (Pahl and Smreciu 1999).

Reclamation Potential

Potential species for reclamation, due to its ability to colonize disturbed sites, in a study comparing abandoned borrow pits in southwestern Canada (Kershaw and Kershaw 1987). It is effective for erosion control and fixes atmospheric nitrogen to increase nitrogen levels in soil (Anderson 2007, Pahl and Smreciu 1999).
It is recommended for use to at least 2,000 m elevation in the Alberta Rocky Mountains and at lower elevations in northern Alberta. It has also been successfully established on capped tailings sands in the Athabasca oil sands region, on un-amended coal mine spoils in several areas of BC, and has shown potential for revegetation of calcareous mine spoils at high elevations in Montana (Pahl and Smreciu 1999). Transplanting of *Astragalus alpinus* has been moderately successful with 53% to 73% on un-amended coal mine soils (Anderson 2007).

Photo Credits

Photo 1: Wild Rose consulting Inc. 2011.
Photo 2 & 3: (smaller) Tracey Slotta @ USDA plants database. (larger) Wild Rose Consulting, Inc. 2010.

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Scientific Name: *Astragalus americanus* (Hook.) M.E. Jones
Family: *Fabaceae*
Common Names: American milk vetch, rattlepod

Plant Description

Tall perennial herb usually with a single erect stem, 50 cm to 1 m tall, sparsely hairy to glabrous; stipules conspicuous, reflexed; the lower nodes marked by stipules only; leaflets 7 to 15, elliptic-oblong, 2 to 4 cm long glabrous; above, sparsely hairy beneath; racemes several, long-peduncled; flowers white, turning yellowish or sordid, 13 to 15 mm long (Moss 1983).
Fruit: Pods drooping, inflated, ellipsoid or ovoid, membranous, 1.5 to 2 cm long, shiny, on stipes 6 to 10 mm long (Moss 1983).
Seed: Kidney shaped, 2 to 3 mm long.

Habitat and Distribution

Stream banks, shaded areas and moist woods (Moss 1983).
Seral Stage: Mid to late seral.
Soil: Tolerant of moderate soil acidity (Tannas 2004).
Distribution: Southeastern Alaska, Yukon, northwestern District of Mackenzie to southwestern Hudson Bay south to British Columbia, Montana, Colorado, Saskatchewan, Manitoba; South Dakota (Moss 1983).

Phenology

Flowers in late June to August.

Pollination

Insect pollinated, obligate outcrosser (Kudo and Harder 2005).

Seed Dispersal

Seed drops from pods when fruit dehisces.

Genetics

2n=16 (Moss 1983).

Symbiosis

Rhizobium bacteria associate with all legume species.

Seed Processing

Collection: For small lots, seed can be collected by cutting, bagging in paper and hanging or spreading to dry (Pahl and Smreciu 1999). Take care to collect before seed are eaten by insects (Lady Bird Johnson Wildflower Center 2007).
Seed Weight: 1.06 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Fruit/Seed by Volume: No literature found.
Average Seed/Fruit: No literature found.
Harvest Dates: Late July to Early August.
Cleaning: Debreading may be used to break up pods (Pahl and Smreciu 1999).
Screen the seed until it is free of excess debris (Pahl and Smreciu 1999).
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: 90% viability following drying to moisture contents in equilibrium with 15% relative humidity and freezing for 10 months at -20°C (Royal Botanic Gardens Kew 2008).
Longevity: No literature found.

Propagation

Natural Regeneration: Emergence from seed.
Germination: 90% germination with pre-treatments on a 1% agar media at temperatures of 15°C, 8 hours light / 16 hours dark (Royal Botanic Gardens Kew 2008).
Pre-treatments: Scarify seed with scalpel (Royal Botanic Gardens Kew 2008).
Direct Seeding: Sow seed stratified in the spring and unstratified in the fall (Lady Bird Johnson Wildflower Center 2007).
Planting Density: No literature found.
Seed Rate: No literature found.

Vegetative Propagation: No literature found.
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: The root could be eaten only in very small amounts during times of starvation (Marles et al. 2000).
Medicinal: The root can be chewed and the juice swallowed to treats stomach aches and cramps (Marles et al. 2000).
Other: Seed pods were use as rattles for babies (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: Good forage value and forms fair quality hay (Tannas 2004).
Grazing Response: Decreaser (Tannas 2004).

Reclamation Potential

Astragalus americanus seed collected in the mountain and foothill regions was removed from a greenhouse seedling production experiment due to poor germination (Smreciu 1995).
Astragalus americanus is tolerant of moderate soil acidity.

Commercial Resources

Availability: No known sources in Alberta (ANPC 2010).
Cultivars: No Literature found.
Uses: No literature found.

Notes

Astragalus americanus is listed as 87% intact (more occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

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Scientific Name: *Astragalus canadensis* L. **Family:** *Fabaceae*

Common Names: Canadian milkvetch, Canada milk-vetch

***Astragalus canadensis* blooming**

Plant Description

Tall erect perennial herb, from creeping root stock, with stout stems 40 to 120 cm high, smooth to slightly hairy; leaflets 13 to 29, elliptic to oblong, 2 to 4 cm long, maybe slightly hairy; flowers greenish yellow or white, 12 to 15 mm long; flower cluster, raceme (Moss 1983).

Fruit: Pods, oblong, rather woody, smooth, beaked (Moss 1983).

Seed: 1.5 to 2 mm light yellow brown to medium brown seed.

Habitat and Distribution

Moist open woodland, banks roadsides, thickets, and streambanks (Moss 1983).

Seral Stage: Mid to late seral.

Soil: Grows in medium textured soils, pH range 6 to 8 (Metcalf et al. 2006). Wet mesic to dry mesic soils (Prairie Moon Nursery n.d.).

No salinity tolerance and moderate drought tolerance (USDA NRCS n.d.).

Distribution: Southwestern District of Mackenzie, British Columbia to Quebec south to California, Colorado, Texas, Arkansas, Virginia (Moss 1983).

Phenology

Flowers from mid July to August (Platt et al. 1974).

Pollination

Insect pollinated mainly by bumble bees (Platt et al. 1974). Do not self-pollinate.

Seed Dispersal

Do not have a mechanism for long distance dispersal of seed; they fall from the seed pod soon after it dries out and dehisces (Platt et al. 1974).

Genetics

2n=16 (Moss 1983).

***Astragalus canadensis* seed**

Symbiosis

Rhizobium bacteria associate with all legume species. *A. canadensis* has been found to be associated with *Mesorhizobium huakuii* in Iowa and Minnesota (Metcalf et al. 2006). The commercial strain of rhizobia recommended by Rhizobium Research Laboratory to inoculate *A. canadensis* is UMR6355 (Graham 2005).

Seed Processing

Collection: Cut and bag, then hang or spread to dry.
Seed Weight: Around 600 seeds/g or 1.67 g/1,000 seeds (USDA NRCS n.d.).
Harvest Dates: All through September (Pleasant Valley Conservancy n.d.). Expect the first significant harvest to be in the second year of growth (based on related species).
Cleaning: Break open pods, screen seeds to remove any remaining chaff.
Storage Behaviour: Orthodox; seeds should be dried prior to storage (Royal Botanic Gardens Kew 2008).
Storage: Long term storage under IPGRI standard conditions (Royal Botanic Gardens Kew 2008).
Longevity: Oldest seed is 15 years old with germination rates that drop from 100% to 90% (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: By seed and rhizomes; plants can live 3 to 4 years (USDA NRCS n.d.).
Germination: Germination can be slow but is usually within four to nine weeks if the seeds are sown fresh (USDA NRCS n.d.). Sorensen and Holden (1974) found that germination of seed increased from 8% to 89% in 12 days after being scarified by lightly rubbing with sand paper.
Pre-treatment: Seeds should be pre-soaked for twenty-four hours in hot water before sowing (USDA NRCS n.d.).
Seed should be mechanically scarified to break dormancy due to hard seed coat and for best results inoculate seed with species-specific rhizobium (USDA NRCS n.d.).
Direct Seeding: Plant seed at a depth of 1 to 2 cm into a firm seedbed. A legume box of a grass seed drill can be used (USDA NRCS n.d.). Seed can also be broadcast and covered by harrowing lightly (USDA NRCS n.d.).
Planting Density: No literature found.
Seed Rate: Planting 0.011 to 0.028 g/m^2 pure live seed as part of a mix should produce adequate densities. Along stream bank corridors 0.11 to 0.22 g/m^2 pure live seed is recommended (USDA NRCS n.d.).
Vegetative Propagation: No literature found.
Micro-propagation: No literature found.
Greenhouse Production: Seeds should be sown in a cold frame as soon as they are ripe. When they are large enough to handle, place the seedlings into individual pots and grow them in the greenhouse for their first winter. Plant in spring or early summer (USDA NRCS n.d.).

Aboriginal/Food Uses

Food: The Blackfoot gathered them in the spring; *A. canadensis* was used in broths (USDA NRCS n.d.).
Medicinal: The root is analgesic and anti-hemorrhagic and can be chewed or used as a tea to treat chest and back pains, coughs and spiting up of blood (USDA NRCS n.d.).

Wildlife/Forage Usage

Wildlife: Attracts hummingbirds, bees and butterflies (Prairie Moon Nursery n.d.).
Palatable to deer (USDA NRCS n.d.).
Livestock: Palatable to livestock (USDA NRCS n.d.).
Grazing Response: No literature found.

Reclamation Potential

Useful for erosion control (USDA NRCS n.d.).

Notes

Seeds are often predated on by buchid beetles making collection of viable seed difficult (Iowa Department of Natural Resources 2011).

Photo Credits

Photo 1: Crazytwoknobs 2011 @ Wikimedia Commons.
Photo 2: Steve Hurst @ USDA-NRCS PLANTS Database.

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Scientific Name: *Campanula rotundifolia* L. **Family**:*Campanulaceae*

Common Name: bluebell, bluebell-of-Scotland, harebell, roundleaf harebell

***Campanula rotundifolia* flowers.**

Plant Description

Erect perennial forb from a taproot, one to several delicate-looking stems 20 to 45 cm tall; stem leaves are alternate, linear to lanceolate (less than 1 cm wide) with smooth margins; basal leaves stalked, kidney to heart shaped with rounded teeth, present when flowering (Moss 1983), all leaves glabrous; one to five flowered in a loose raceme with blue to blue-violet (occasionally white) bell-shaped nodding or (occasionally) erect flowers, 15 to 25 mm long with 5 sepals, 5 campanulate petals, 5 stamens and 1 pistil (Royer and Dickinson 2007).

Fruit: Capsule 5 to 8 mm long producing many seeds.

Seed: 1 to 1.5 mm long, oblong-elliptical, brown to black, shiny, striate surface with a peripheral ridge on one side.

Habitat and Distribution

Circumboreal on moist to dry hillsides, meadows and open woods, rocky sites and outcrops to alpine elevations (Moss 1983).

Seral Stage: Early seral, quick to respond to changes in land use (Lindborg et al. 2005).

Soil: Dry, sandy well drained soils (Lady Bird Johnson Wildflower Center 2013).

Distribution: Found throughout Canada and most of the US with the exception of Nevada, Hawaii and several south eastern states (USDA NRCS n.d.).

***Campanula rotundifolia* flowers.**

Common throughout Alberta (Royer and Dickinson 2007).
Circumpolar; Alaska, Yukon, southwestern District of Mackenzie to James Bay, northern Quebec, Newfoundland south to California, New Mexico, Texas, Nebraska, Iowa, Pennsylvania, New Jersey (Moss 1983).

Phenology

Plants flower June to August, often into September ALCLA n.d.), and seeds mature from August to October (Pahl and Smreciu 1999).

Pollination

Pollinated primarily by bumblebees and solitary bees (Bingham and Orthner 1998).
This species is protandrous; that is, pollen is released before the stigma on the same flower is receptive (Nyman 1992).
Cross pollination results in greater seeds per capsule than self-pollination (Nuortila et al. 2004).

Seed Dispersal

Seed may be wind dispersed (Royal Botanic Gardens Kew 2008) or by water and gravity (Shelter and Morin 1986).

Genetics

2n=34, 68,102 (Moss 1983) or n=17, 28, 34 (Shelter 1963).

Symbiosis

C. rotundifolia forms vesicular-arbuscular mycorrhizal associations with *Glomus* spp. (Currah and Van Dyk 1986, Nuortila et al. 2004).
Campanula benefits from mycorrhizal association in some respects such as seed and root phosphorus concentration, root/shoot ratios and seedling growth rate, but this association may reduce plant size and seed production potential (Nuortila et al. 2004).

Seed Processing

Collection: Capsules can be hand harvested (Smreciu and Gould 2010).
Seed Weight: Average 0.03 to 0.06 g/1,000 seeds (Royal Botanic Gardens Kew 2008, Wick et al. 2008).
Average Seeds/Fruit: Ranges from 54 to 108 seeds per fruit (Giblin 2005).
Harvest Dates: Mid-September to mid-October (Pahl and Smreciu 1999).
Cleaning: Scalping may be required to remove smaller chaff. To clean, use a screen shaker and a seed blower with 1/25 inch round top screen and 45 x 45 mesh bottom screen (Pahl and Smreciu 1999).
Storage Behaviour: Orthodox, seeds may be dried to low relatively humidity without damage (Royal Botanic Gardens Kew 2008).
Storage: Store dry seeds (5% to 8% moisture content) at 18 to 20°C (Liu et al. 2008). IPGRI preferred storage conditions; low moisture content (3% to 7% fresh weight, depending on the species) and storing them, in hermetically-sealed containers, at low temperature; -18ºC or cooler (Fassil and Engels 1997, Royal Botanic Gardens Kew 2008).
Longevity: Oldest collection 24 years old with seed increasing its germination percentage from 76% to 90% (Royal Botanic Gardens Kew 2008).

***Campanula rotundifolia* seeds.**

Propagation

Natural Regeneration: In natural Norwegian seed banks, vegetative sprout densities were found to be between 21 to 1,060/m^2 and 94 to 711/m^2, germination percentages were found to be 15% to 40%, seed bank densities of seedlings were 21 to 374/m^2 (Alsos et al. 2003).

Seedling emergence may benefit from low levels of litter input (Hovstad and Ohlson 2008).

Germination: 76% to 100% germination was reached on 1% agar at temperatures varying between 15 to 25°C, in some treatments 250 mg/l of gibberellic acid was added to the agar. One treatment received a cold stratification treatment at 2°C on agar and it produced the lowest percentage of germinants (Royal Botanic Gardens Kew 2008).

Seed: Seeds should be sown indoors, not covered after sowing and bottom watered (Lady Bird Johnson Wildflower Center 2013).

In stored seeds, germination percentages were 88% under treatment of 16°C and 12h light and 12 h dark (Godefroid et al. 2010).

Pahl and Smreciu (1999) had 82% seed germination in 5 to 14 days after stratification pre-treatment.

Wick et al. (2008) used the following: pre-planting treatment of 90 day cold, moist stratification followed by direct seeding with 6:1:1 milled sphagnum peat, perlite, and vermiculite with Osmocote controlled release and Micromax fertilizers. Germination continued over 4 weeks and total time to harvest was 9 months.

Vegetative Propagation: By root or stem cuttings in damp sandy soil (Lady Bird Johnson Wildflower Center 2013). Van Dyk and Currah (1982) recommend dividing mature plants.

Aboriginal Food/Uses

Medicinal: Roots are used to stop bleeding and decrease swelling when applied as a compress (Royer and Dickinson 1996). Roots may be chewed to alleviate heart ailments (Royer and Dickinson 1996, 2007). Chippewans used an infusion of the roots to treat sore ears (Densmore 1928), and Thompson Indians used a decoction as a wash for sore eyes (Turner et al. 1990).

Wildlife/Forage Usage

Attracts hummingbirds (Lady Bird Johnson Wildflower Center 2013). Ants may play a role in dispersal (Shelter and Morin 1986). Rabbits likely eat the inflorescences (Farrow 1917).

Reclamation Potential

C. rotundifolia seems to be a hardy plant able to persist in poorer quality sites and responds quickly to improved conditions in restored grassland (Lindborg et al. 2005, Lindborg and Eriksson 2004).

C. rotundifolia spreads quickly in later seral stages in open sites, particularly in gravely or shallow soils (Pahl and Smreciu 1999).

Commercial Resources

Harvest Methods: Swath and bale tough; spread dry; thresh (Pahl and Smreciu 1999).

Uses: As a garden ornamental.

Notes

Synonyms include *C. sacajaweana*, *C. alaskana*, *C. petiolata*, *C. dubia*, *C. heterodoxa* and *C. intercedens*, none of which are valid (ITIS n.d.).

C. rotundifolia is listed as 100% intact in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo credits

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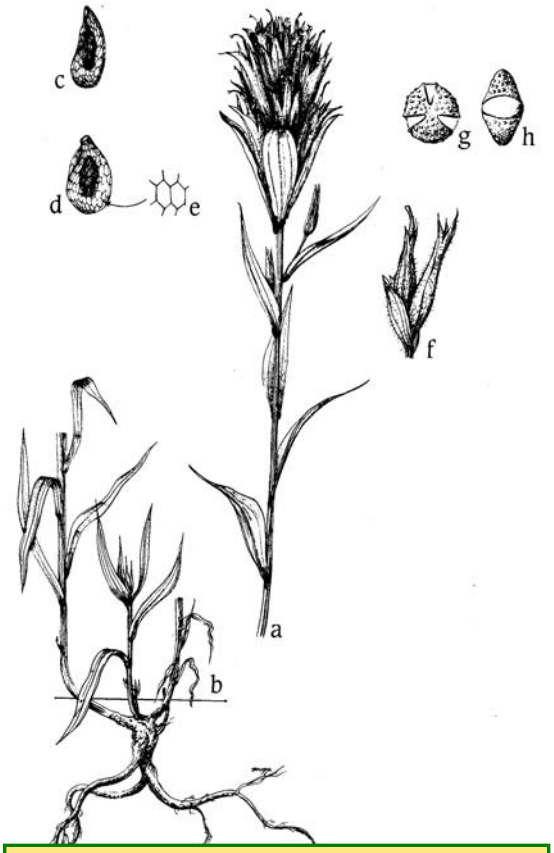
Scientific Name: *Castilleja miniata* Dougl. *ex.* Hook.
Family: *Scrophulariaceae*
Common Names: common red paintbrush, giant red Indian paintbrush, scarlet paintbrush



***Castilleja miniata* a) inflorescence, b) underground growth, rhizome, c-d) seed, e) seed texture, reticulation, f) flower including bract, g-h) pollen grain.**

Plant Description

Perennial herb; stems are mostly 20 to 60 cm tall, glabrous or somewhat hairy; leaves, alternate and sessile, narrowly lanceolate to ovate, three-nerved, usually glabrous, entire or shallowly three-lobed; showy bracts red or yellowish, entire or cleft; calyx 1.5 to 2.5 cm long, subequally cleft above and below; corolla 2 to 3.5 cm long, the galea more than half as long as the corolla-tube (Moss 1983).
Seed: Reticulated in honeycomb pattern (Moss 1983).

Habitat and Distribution

Open woods and meadows (Moss 1983).
Wet to dry meadows, grassy slopes, fens, tidal marches, clearings, roadsides, thickets and open forests (E-Flora BC 2013).
Seral Stage: Early.
Soil: Wet to moist, well-drained soils (Lady Bird Johnson Wildflower Center 2013).
Distribution: Throughout Alberta. Southern Alaska, British Columbia to Manitoba, south to California, New Mexico (Moss 1983).

Phenology

Flowers from June to August (Lady Bird Johnson Wildflower Center 2013).

Pollination

Castilleja genus is generally pollinated by hummingbirds and is self-pollinating (Lady Bird Johnson Wildflower Center 2013).

Seed Dispersal

Castilleja seeds are carried short distances by wind, but are usually just dropped to the base of the plant (Caplow 2004).

Genetics

2n=24, 48, 72, 96, 120 (Moss 1983).

Symbiosis

Roots grow until they touch the roots of other plants, frequently grasses, then penetrate the roots of these host plants obtaining a portion of their nutrients (Lady Bird Johnson Wildflower Center 2013).

Seed Processing

Collection: Care should be taken to avoid pulling up the plants by the fragile roots when removing the

seed head. The tops can be cut to prevent damage to the delicate plant (Lady Bird Johnson Wildflower Center 2013).
Harvest Dates: Late July and late August (Lady Bird Johnson Wildflower Center 2013).
Cleaning: Air-dry fruits; crush material or remove large chaff and crush remaining material; sieve to remove seeds from chaff using appropriate size screens; small chaff and dust can be removed by winnowing; if capsules are intact merely open capsules and empty seeds, sieve or winnow to remove chaff (Hong et al. 1998).
Storage: Store dry in sealed containers (light weight seeds are easily blown away).
Storage Behaviour: Orthodox (Hong et al. 1998).
Longevity: No literature found.

Propagation

Natural Regeneration: Emerges from seed.
Germination: Cold stratification of 30 days is likely sufficient to break dormancy and seedlings will emerge well when sown (based on work with *C. raupii*).
Pre-treatment: Cold stratification may be required (Smreciu et al. 2006).
Direct Seeding: Some success has been reported with similar species (*C. raupii*) directly sown in north-eastern Alberta. Sow with another herbaceous perennial for best results (Lady Bird Johnson Wildflower Center 2013).
Seeding Rate: 200 seeds/m^2 was sufficient to establish *C. raupii* in north-eastern Alberta, but a higher rate is recommended.

Aboriginal/Food Uses

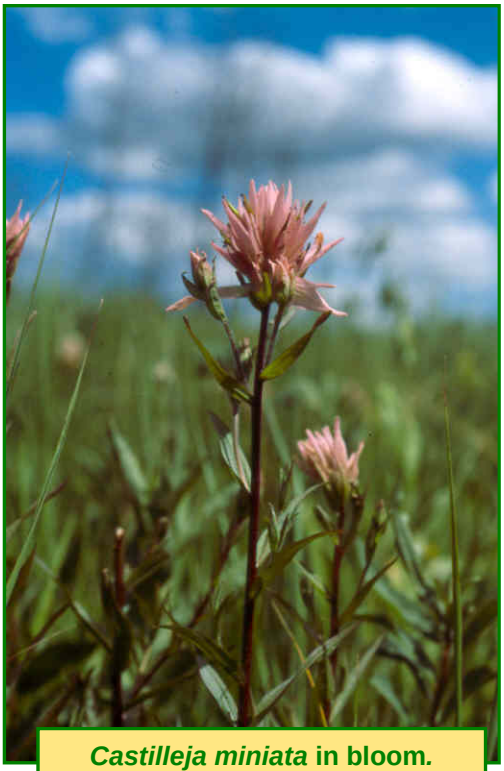
Medicinal: Flower heads can be dried and mixed with wild chamomile flowers to make a tea for headache treatment (Marles et al. 2000).
Other: An attractive ornamental (Marles et al. 2000).

Wildlife/Forage Usage

Livestock: Poor to fair forage value although fairly palatable (Tannas 2004).
Grazing Response: Although an increaser. *Castilleja* is rarely aggressive due to the taproot growth habit and reliance on associated vegetation (Tannas 2004).

Reclamation Potential

An early seral species with few germination requirements, it is expected that *Castilleja miniata* would be an excellent addition to pioneering seed mixes.



***Castilleja miniata* in bloom.**

Commercial Resources

Availability: Seeds and plants are commercially available in Alberta (ANPC 2010).
Uses: Often used as an ornamental in horticultural gardens (Lady Bird Johnson Wildflower Center 2013).

Notes

C. miniata is listed as 88% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photos: Wild Rose Consulting, Inc.

Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Castilleja raupii* Pennell **Family:** *Scrophulariaceae*

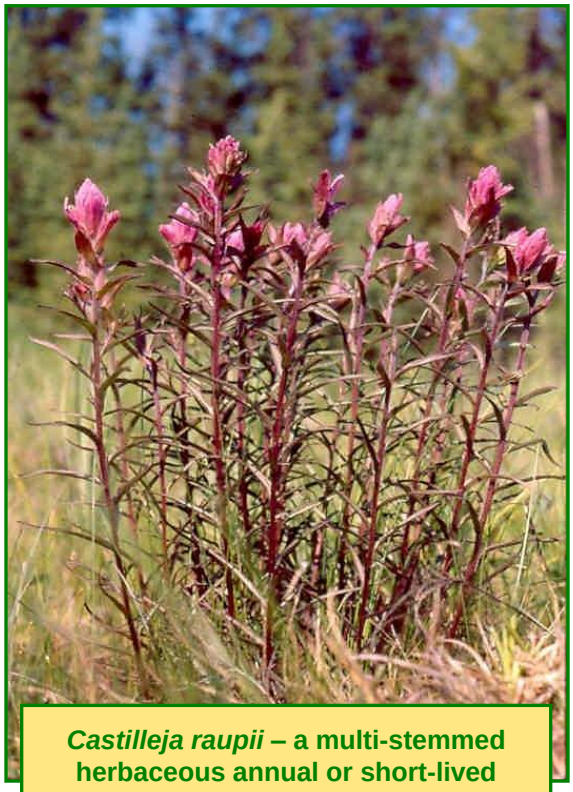
Common Names: purple paintbrush, Raup's Indian paintbrush

Plant Description

Erect short-lived perennial herb, 30 to 50 cm high; slender, green or purplish stem, distinctly hairy; leaves alternate, linear, sessile 4 to 5 cm long; dense terminal spikes; brightly pink to purple bracts are more obvious than petals, oval to lance-shaped, paired, fuzzy; short weak roots, partially parasitic (Moss 1983).

Fruit: Oval shaped capsule is more pointed than egg-shaped (Moss 1983).

Seed: 1.5 to 3 mm long, silvery, irregularly shaped seeds, ridged, honeycomb-like surface texture (Moss 1983).



***Castilleja raupii* – a multi-stemmed herbaceous annual or short-lived perennial.**

Habitat and Distribution

Habitat: Roadsides, open moist forests, forest margins, grassy areas, bogs and shores (Moss 1983).

Seral Stage: Early to mid seral.

Soils: Moist to well drained soils with some organic matter (Moss 1983).

Distribution: Boreal forests of Alberta. Alaska, Yukon, District of Mackenzie to James Bay south to northern British Columbia, Alberta, Saskatchewan, northeastern Manitoba (Moss 1983).

Phenology

Bracts gain colour and plant blooms in late June and July. Seeds ripen in late July and August.

Pollination

The *Castilleja* genus is generally pollinated by hummingbirds (CYSIP: Botany n.d.) as well as self-pollinating.

Genetics

2n=72 (Moss 1983).

Symbiosis

Partially parasitic (CYSIP: Botany n.d.); infecting roots of a wide range of angiosperm families. This parasitic habit increases its vigour with more branching, greater height and earlier flowering (Heckard 1962).

Seed Processing

Collection: Harvest upper stems by cutting just below the seed capsules. Care should be taken to avoid pulling up plants due to weak roots (Luna 2005).

Seed Weight: 0.06 to 0.09 g/1,000 seeds (0.07 average).

Harvest Dates: Late July and late August.

Cleaning: Air-dry fruits. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing. If capsules are intact merely open capsules and empty seeds; sieve or winnow to remove chaff.
Storage Behaviour: This genus is reported to be orthodox (Royal Botanic Gardens Kew 2008)
Storage: Store dry in sealed containers (seeds are light weight and easily blown away).
Longevity: Seed harvested in north-eastern Alberta are viable for at least two years.

Propagation

Natural Regeneration: Emerges from seed (Gerling et al. 1996). They require a host plant to grow successfully; without a host they may grow stunted and/or die (Luna 2005).
Germination: More than 80% in 30 days with fresh, 1 or 2 year old seed in northeastern Alberta. Luna (2005) observed that seeds for *Castilleja* spp. collected at lower elevations had greater germination percentages the seeds collected at higher elevations. Stratified seeds germinate 10 to 14 days after they are sown in greenhouse (Luna 2005).
Pre-treatment: Cold stratification of 30 days. Luna (2005) working with *Castilleja* species, first imbibed seed with water for 4 to 8 hours, poured all water off and then cold stratified them for 30 to 150 days at 1 to 2°C. A non-aggressive or weakly rhizomatous host plant should also be selected to grow with *Castilleja* spp. (Luna 2005).
Direct Seeding: 0.43% emergence after the first year and fully established by year four (flowering, producing seeds and spreading) on oil sands reclamation sites in north-eastern Alberta.
Seeding Rate: 500 seeds/m² to obtain 2 plants/m² – these will spread by seed to produce a much greater density after 3 to 5 years (Wild Rose Consulting Inc. 2013).

Aboriginal/Food Uses

Connected to love charms and used in medicines (CYSIP: Botany n.d., Gerling et al. 1996).

***Castilleja raupii* seedling growing in a direct-seeded revegetation plot.**

Wildlife/Forage Usage

Wildlife: Fair forage value (Gerling et al. 1996).
Livestock: Poor forage value (Gerling et al. 1996).
Grazing Response: Increases in abundance following grazing (Gerling et al. 1996).

Reclamation Potential

Was evaluated in Churchill Manitoba to determine its ability to revegetate heavily gravelled areas; the study resulted in no germination in the first season and a low to moderate germination rate when it did come up (Rausch and Kershaw 2007).

Commercial Resources

Availability: Plants are occasionally available from local Alberta nurseries, collections from native populations preferred for reclamation.
Is available as seed in Alberta (ANPC 2010).

Photo Credit

Photos: Wild Rose Consulting, Inc. 2012.

References

ANPC (Alberta Native Plant Council), 2010. Native Plant Source List. http://www.anpc.ab.ca/assets/ANPC_2010_Native_Plant_Source_List.pdf [Last accessed June 14, 2013].

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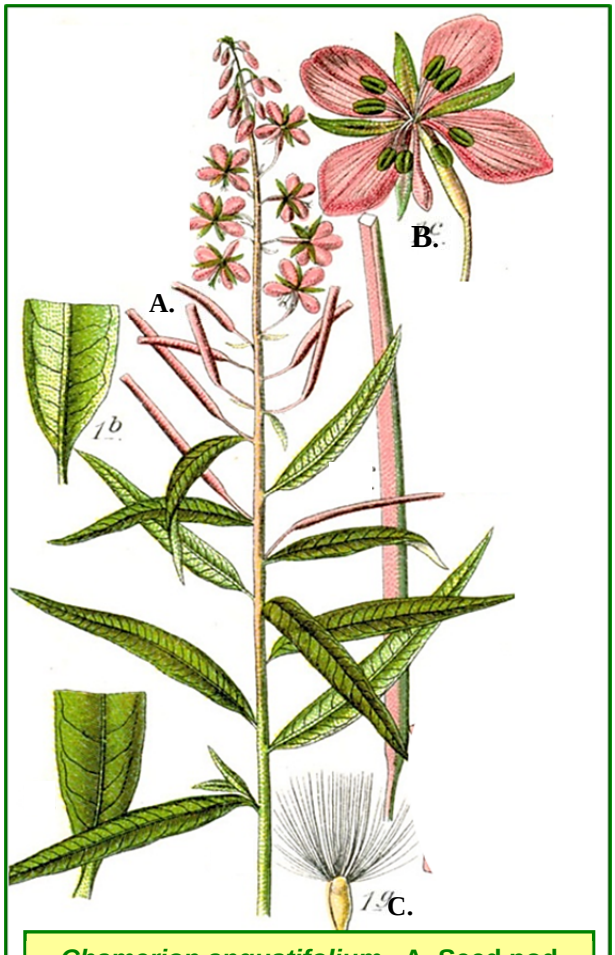
Smreciu, A., K. Gould and S. Wood, 2013. Establishment of native boreal plant species on reclaimed oil sands mining disturbances. Interim Report. Prepared for Canadian Oil Sands Network for Research and Development. 45 pp. + appendices.

Scientific Name: *Chamerion angustifolium* L. Holub. **Family:** *Onagraceae*

Common Names: fireweed, great willow-herb

Plant Description

Stems 1.3 to 3 m tall, unbranched with creeping rhizome, forming colonies; leaves alternate, lance-shaped, 1.5 to 20 cm long, 0.5 to 35 mm wide and predominately veined, short stalked; margins smooth to wavy; inflorescence raceme, large, terminal, 8 to 80 flowered, nodding in bud; flowers pink to light purple (occasionally white), 2 to 3 cm across, 4 sepals, 4 petals, 8 stamens, 1 pistil; stigma 4-lobed and nodding (Royer and Dickinson 2007).



***Chamerion angustifolium*. A. Seed pod B. Flower C. Seed**

***Chamerion angustifolium* in flower.**

Fruit: Capsule 4 to 10 cm long pinkish green, often 4-sided (Royer and Dickinson 2007).
Seed: Seeds are small, dark brown and numerous with white hairs (Royer and Dickinson 2007, USDA NRCS n.d.).

Habitat and Distribution

Open forests, riverbanks, gravel bars, waste ground, roadsides and areas subjected to forest fires (Moss 1983, Royer and Dickinson 2007).
Seral Stage: Pioneer species (Pavek 1992).
Soil: Found on soils ranging from clays to sandy loams. Most prevalent on disturbed soils. Tolerant

of acidic conditions and rolling to steep slopes (Pavek 1992).
They survive within a pH range 4.8 to 7 and have no salinity tolerance (USDA NRCS n.d.).
Distribution: Circumpolar and throughout Alberta. Alaska, Yukon, District of Mackenzie to southern Baffin Island to Newfoundland south to California, Arizona, New Mexico, South Dakota, Ohio, North Carolina (Moss 1983).

Phenology

Blooms July and August. Capsules begin forming at the end of July with the majority ripe in late August.

Pollination

Chamerion is pollinated by insects (Rook 2002). Wolfe et al. (2005) found that arbuscular mycorrhizal associations increased the size of *Chamerion* inflorescences, which in turn increased the likelihood of pollination by insects.

Seed Dispersal

Wind (Luna and Dedekam 2008).

Genetics

2n=36, 72, 108 (Moss 1983).

Symbiosis

Broderick (1990) noted the establishment of mycorrhizal associations on a coal mine site being reclaimed. Wolfe et al. (2005) found arbuscular mycorrhizal associations.

Seed Processing

Collection: Cut or snap off top portion of stem. Place in breathable bag (paper or Tyvek) to allow further ripening and drying.
Seed Weight: 41 g/1,000 seed (Thompson et al. 1993).
Average Seed/Fruit: 300 to 500 seeds/fruit (Aiken et al. 2007).
Harvest Dates: Mid to late August.
Cleaning: Use blender with dulled or wrapped blades on a low speed and pulse. Attention must be made to the quantity of seed blended at once; too little material will not allow for adequate abrasion, while too much will result in uneven abrasion. Follow with sieving/winnowing (Scianna 2002). Forced air through a series of screens can also be used to remove fluff.
The tiny seed and silky hairs (that aid in wind dispersal) makes this species very difficult to feed into cleaning equipment (Barner 2009).
Storage Behaviour: Possibly orthodox (Royal Botanic Gardens Kew 2008).
Storage: Store dry in sealed containers.
Longevity: Found to be unsuccessful in long term seed banking (Pavek 1992).
Fireweed seeds stored at 1 to 3° C in sealed containers remain viable for at least a few years (Luna and Dedakam 2008). Rarely viable after 3 years (Aiken et al. 2007).
If seed is orthodox, longevity might be improved by storing seed frozen.

***Chamerion angustifolia* capsules after bursting**

Propagation

Natural Regeneration: Spreads by rhizomes (Pavek 1992) and by light seed which is widely dispersed. Seeds remain viable in natural seed bank for many years (Luna and Dedekam 2008).

Germination: Up to 75% germination with fresh seed from north-eastern Alberta (Smreciu et al. 2008). Royal Botanic Gardens Kew (2008) achieved 80% to 100% germination with varying temperature (15 to 25°C) and light exposure regime.
Pre-treatment: None required for seed harvested in north-eastern Alberta (Smreciu et al. 2008).
30 day cold stratification was found to be successful (Baskin and Baskin 2002).
Direct Seeding: In a study in north-eastern Alberta, *C. angustifolium* established a cover on recently disturbed sites so consistent as to be indistinguishable from direct sowing (Smreciu et al. 2008).
Vegetative Propagation: Reproduces vegetatively by rhizomes, and so may be propagated from cuttings.
Micro-propagation: Root explants may be excised from sterile seedlings and cultured. Browning is a problem which can be countered with citric or ascorbic acids to prevent oxidation. Murashige and Skoog's minimal organics containing a combination of Kinetin with 2, 4-dichlorophenoxyacetic acid or benzyladenine with indole-3-acetic acid (Turker et al. 2008).

***Chamerion angustifolia* seed. Black line is 0.5 mm**

Aboriginal/Food Uses

Food: Widely used as greens raw or cooked, young shoots taste like asparagus (Gray 2011). Stem pith was added to soups as a thickener or dried, boiled and fermented to make ale; was also used in teas (MacKinnon et al. 2009, Turner 1997). Used to make fireweed jelly (Gray 2011).
Medicinal: Used to treat prostate problems, teas were used to treat asthma and whooping cough; peeled roots were applied to burns, swellings, boils, sores and rashes and leaves used to treat mouth ulcers. *Chamerion* was also used to treat yeast infections, hemorrhoids and diarrhea (MacKinnon et al. 2009). Has a mild laxative effect and is used to dispel intestinal worms (Gray 2011).
Other: Stem fibres were used to make fish nets and cord, fireweed flowers were rubbed into raw hide for waterproofing. Seed fluff was used for blankets, clothing and tinder (MacKinnon et al. 2009). Shacklette (1964) reported that uranium contamination causes mutations producing white headed flowers; this could be used to find uranium deposits.

Wildlife/Forage Usage

Wildlife: Moose, elk, white-tailed deer, woodland caribou and bighorn sheep have been known to eat the foliage whereas, muskrats, and hares and small mammals eat seeds (Rook 2002).
Livestock: Has a good to poor palatability changing over seasons and sites (Pavek 1992). Cattle and sheep use it more for forage than horses do (Tannas 2004).
Grazing Response: Increaser (Tannas 2004).

Reclamation Potential

In a survey of plant invasion into reclaimed areas on Syncrude and Suncor, Hardy BBT Limited (1990) found *C. angustifolium* to be the most common invader and to have the highest cover. Geographic Dynamics Corp. (2006) reviewed Syncrude and Suncor plot data and found the same result though they noted a decline in cover and presence after 15 to 20 years.
C. angustifolium has been successfully used to reclaim mining disturbances in the alpine and subalpine regions of Western Canada. It has been found to successfully colonize following manual seeding and natural dispersal. It is recommended for

its ground cover abilities, and colonization speed, a result of its rhizomatous nature. *C. angustifolium* can tolerate moderately steep slopes, which makes it beneficial for erosion control. However, this species may cause problems in conifer seedling establishment, contributing to root rot and shading out the seedlings (Pavek 1992). Despite this possibility, it has been suggested as a nurse crop for aspen (Landhausser pers. comm.).

Pinno et al. (2014) studied fireweed growth response to various oil sands reclamation soil types and fertilizer regimes in the greenhouse. They concluded that fireweed shows promise for reclamation as it was capable of growing in reclamation soils and taking up nutrients thus promoting nutrient capture and accumulation, and likely nutrient cycling.

Naguit et al. (2013) reported that seeding 0.5 kg/ha of *C. angustifolium* on gold tailings (pH 5.5) near Flin Flon, Manitoba resulted in no seedlings after 4 and 9 years.

Commercial Resources

Availability: Commercially available but not on a large scale and not suitable for reclamation in Alberta (Alberta Native Plant Council 2010).

Cultivars: No literature found.

Uses: Common ornamental.

Notes

Synonym *Epilobium angustifolium* L. (ITIS n.d.).

Chamerion angustifolium is listed as 94% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Chamerion angustifolium seed does not remain in the soil seed bank after fire disturbance (Baskin and Baskin 2002).

Is the Territorial flower of Yukon Territory (Gray 2011).

Photo Credits

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Photo 2: Dcrsr 2010. Wikimedia Commons.

Photo 3: Frank Vincentz 2007. Wikimedia Commons.

Photo 4: Jose Hernandez @ USDA-NRCS PLANTS Database 2012.

Line drawing: Johann Georg Sturm 1796 (Painter: Jacob Sturm) @ Wikimedia commons.

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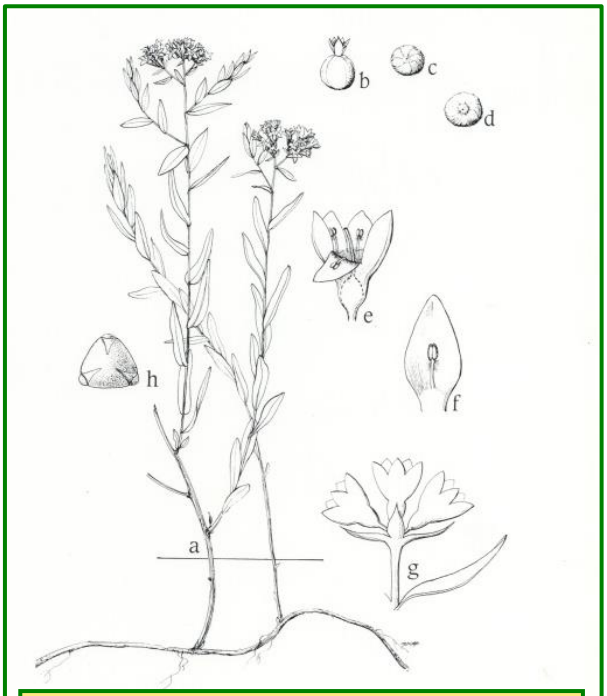
Scientific Name: *Comandra umbellata* L. Nutt **Family:** *Santalaceae*

Common Names: bastard toadflax, pale comandra

Plant Description

Perennial, grows from creeping, white rhizomes; roots are parasitic on neighbouring plants. Stems are hairless, usually branched and grow 15 to 40 cm tall; leaves are numerous, alternate, short- or no-stalked, linear to lance-shaped or narrowly oblong, 1 to 3 cm long, hairless, pale and glaucous; flowers are 4 to 8 mm long, greenish white to purplish, and narrow into a short neck; several to many 3 to 5 flowered clusters form larger ovoid clusters at the tip of stem; flowers have no petals, instead 5 petal-like sepals, each 2 to 5mm long (Johnson et al. 1995, Moss 1983).

Fruit: Green to drab purplish brown, dry to slightly fleshy, egg-shaped to spherical, remains of calyx at tip, 3 to 8 mm in diameter; contains 1 seed (Johnson et al. 1995).



Comandra umbellata illustration a. habit: shows inflorescence, leaves, rhizomes and roots b. fruit c-d. seeds e. flower f. petal and stamen g. inflorescence h. pollen

Seed: 5 to 7 mm long, light brown, glabrous, globose (Currah et al. 1983).

Habitat and Distribution

Occur in prairie grasslands, on gravelly slopes, and in dry open pine woods (Moss 1983). Widely scattered in southern boreal forest and parkland (Johnson et al. 1995). Commonly found on upper slopes with south exposures (Currah et al. 1983).

Seral Stage: Mid seral.

Soil: Moist to dry, generally well drained; can grow in sandy or gravelly areas (Tannas 2004).
Tolerant of high acid soils (Plants for a Future n.d.).

Distribution: All of continental North America excluding Nunavut, Florida and Louisiana (USDA NRCS n.d.).
British Columbia, northern Alberta to central Manitoba, Lake Superior to Newfoundland south to California, Arizona, New Mexico, Texas, Georgia; Hudson Bay (Moss 1983).

Phenology

In Virginia, *C. umbellata* has been observed flowering from April 24 to June 11, and fruiting from May 25 to July 26 (Musselman 1982). In Waterton Lakes National Park, flowering of lower elevation plants starts by the middle of May (Kuijt 1982). Currah et al. (1983) describes *C. pallida* (a ssp. of *C. umbellata*) in the prairies as emerging in late April to May, budding in May, and flowering May to June, with seeds ripening in July.

Pollination

Insect pollinated (USDA NRCS n.d.).

Seed Dispersal

No literature found.

Genetics

2n= 26 (Moss 1983).

Symbiosis

Actively mycorrhizal; semi-parasitic with a wide host range (Currah et al. 1983, ITIS n.d.).
Larval host and/or nectar source for the common buckeye (*Junonia coenia*)(ITIS n.d.).

Seed Processing

Collection: Hand harvest.
Seed Weight: 89.122g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: July (Currah et al. 1983).
Cleaning: No literature found.
Storage Behaviour: No literature found.
Storage: No literature found.
Longevity: No literature found.

Propagation

Natural Regeneration: Few seeds per plant (Currah et al. 1983)
Germination: Probably room temperature; seeds do not require host stimulus for germination and seedlings can become established without direct contact to a host (Baskin and Baskin 2001). Germination rate poor (Currah et al. 1983).
Pre-treatment: Seeds are most likely in a state of morpho-physiological dormancy; the requirements for embryo growth and dormancy break have not been determined (Baskin and Baskin 2001). Stratify for 3 months at 5°C and then sow in a greenhouse in a pot with a suitable host; plant out near a mature host plant when well established (Plants for a Future n.d.).
Direct Seeding: No literature found.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: Likely by rhizome division (Currah et al. 1983).
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: The fruit is edible and was used as a snack by western native peoples, but eating too many may cause nausea. Best eaten when fully grown, but still slightly green, as the fruit becomes less palatable with ripening (Kershaw et al. 1998). Consumption is not recommended, however, since the fruit may accumulate toxic levels of selenium (Marles et al. 2000).
Medicinal: Has been used medicinally by the Cherokee as a dermatological aid applied to cuts/sores and for the kidneys, by the Meskwaki for lung pains and as a cold remedy, and by the Navajo as a foot bath for corns, a mouth wash for canker sores, an eye medicine, and as a narcotic (USDA NRCS n.d.).
Other: Flowers sucked by children for nectar (USDA NRCS n.d.).

Comandra umbellata in bloom

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: Considered of poor forage value (Tannas 2004).
Grazing Response: Increaser (Tannas 2004).

Reclamation Potential

C. umbellata is frequently found growing on exposed, coarse soils and may, to a limited extent, function as a stabilizer in these conditions (Tannas 2004). It must be planted near other plants that it can parasitize (Johnson et al. 1995).

Notes

C. umbellata is a secondary selenium accumulator (Tannas 2004).

Photo Credits

Photo 1: Darel Hess http://bioimages.vanderbilt.edu
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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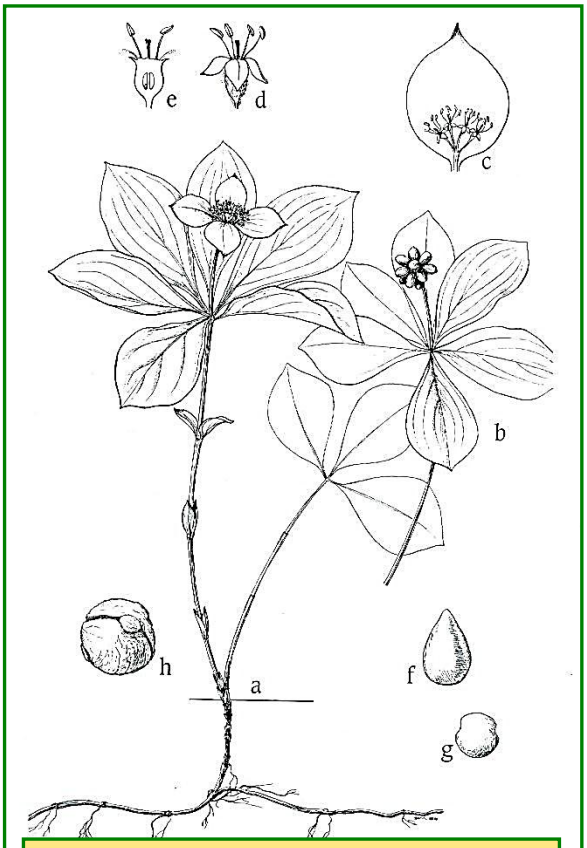
Scientific Name: *Cornus canadensis* L. **Family:** *Cornaceae*

Common Names: bunchberry, bunchberry dogwood, creeping dogwood, pigeonberry

Plant Description

Low herbaceous perennial forming colonies by spreading rhizomes; stems erect, simple, 8 to 18 cm long; leaves sessile, elliptic-ovate to obovate or rhombic, tapering to the base, 4 to 6 forming a whorl near apex, lower leaves reduced and in remote pairs, flower cluster on a short peduncle; bracts, or the involucre, white to cream, greenish when immature, ovate, 1 to 2 cm long; flowers inconspicuous (Gucker 2012).



***Cornus canadensis* - a. Entire plant showing growth habit b. fruit above the whorl of leaves c. flowering head d to e. flower details f to g. seed h. pollen.**

Fruit: Drupe bright red, 6 to 8 mm diameter, borne in clusters (Gucker 2012).
Seed: Round, pale, 2 x 4 mm (Gucker 2012).

Habitat and Distribution

Dominant forb under *Pinus contorta* in Alberta. Mesophytic, prefers moist conditions (Gucker 2012).
Seral Stage: mid to late stages.
Soils: Prefers acidic soils (pH 5.5 to 6.9) (Gerling et al. 1996).
Has no tolerance to salt (USDA NRCS n.d.).
Distribution: In parkland, boreal and montane regions of Alberta. Alaska, Yukon, western District of Mackenzie to Hudson Bay, Newfoundland south to California, New Mexico, South Dakota, Ohio, Pennsylvania, New Jersey (Gucker 2012, Moss 1983).

Inconspicuous flowers and showy bracts of *Cornus canadensis*.

Phenology

Plants flower in June; fruit ripens in August and September (Plants for a Future n.d.).

Pollination

Insect pollinated by bumblebees, solitary bees, beeflies and syrphid flies (Gucker 2012).
C. canadensis anthers are capable of catapulting their pollen into the air (2.5 cm in the air in a windless laboratory) which is said to assist in both wind and insect pollination (Whitaker et al. 2007).

Seed Dispersal

Dispersed by insects like ants, birds and rodents (Burger 1987).

***Cornus canadensis* growing in its natural habitat.**

Genetics

2n=22 (Gucker 2012).

Symbiosis

Shaw (1973) reported associations between *Cornus canadensis* and the following fungal species: *Glomerularia corni, Phyllactinia guttata, Puccinia porphyrogenita, and Phyllosticta* sp.

Seed Processing

Collection: Harvest by hand.
Seed Weight: 10.67 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Fruit/Seed Volume: 2,776 fruit/L average (2,776 seeds/L fruit).
Fruit/Seed Weight: 7,886 fruit/kg (7,886 seeds/kg fruit).
150 seeds/g (Gerling et al. 1996), 38 seeds/g (Smreciu and Gould 2009).
Average Seeds/Fruit: One.
Harvest Dates: Mid-August to mid-September.
Cleaning: Macerate fruit in blender with equal part water, decant pulp and chaff; rinse and repeat as necessary; allow seed to dry in moving air stream (Wick et al. 2008).
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents. Longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Store dry at cool temperatures (Wick et al. 2008).
Longevity: Seed remains viable for 2 to 4 years (Wick et al. 2008).

Propagation

Natural Regeneration: Spreads primarily by rhizomes (Gucker 2012).
Germination: Must be cleaned due to inhibitors in fruit (Plants for a Future n.d.).
Seeds in past experiments germinated in greenhouse conditions (Baskin and Baskin 2001).
Pre-treatment: Warm stratify (25°C) for two months then cold stratify for five months (Young and Young 1992).
71 to 112 day cold stratification was done outdoors in Connecticut before seeds were sown (Baskin and Baskin 2001).
Vegetative Propagation: Divide in spring by teasing small divisions from side of main clump (Plants for a Future n.d.).
Haynes and Smagula (2003) found cuttings made in April with rhizomes were more successful than those made without rhizomes or in June.
Planting Density: 1,100 to 1,900 plants/hectare (USDA NRCS n.d.).

Aboriginal/Food Uses

Food: Fruit can be eaten fresh, but is unpalatable (dry and tasteless – Droppo 1987). Fruit can be added to jams, pies and puddings, particularly those of low-

pectin fruits, to increase pectin levels (Plants for a Future n.d.).
Medicinal: Tea can be used to treat a 'sore heart', possibly heartburn. Leaves and stems are analgesic and cathartic – tea being used for a variety of aches and pains (Plants for a Future n.d.). A strong decoction and strained root mash have been used as eyewash to treat sore eyes (Plants for a Future n.d.).

Bunchberry seeds about 2 x 4 mm.

Wildlife/Forage Usage

Wildlife: Forage source for a variety of large ungulates, birds and rodents (Gucker 2012).
Livestock: Poor forage value for livestock (Gerling et al. 1996). Low palatability for browsers and grazers (Gucker 2012).
Grazing Response: Increaser/decreaser (Gerling et al. 1996).

Reclamation Potential

Highly fire resistant, long lifespan, re-sprouts.

Commercial Resources

Availability: Seed and plants are commercially available in Alberta (ANPC 2010).
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Cultivars: None known.
Uses: Ornamental ground cover (Gucker 2012).

Notes

C. canadensis is listed as 89% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
The Cree call bunchberry *kawiscowimin*, meaning *itchy chin berry*, a reference to the rough surface of the leaves (Royer and Dickinson 1996).

Photo Credits

Photos 1 to 2: Glen Lee, Regina, Saskatchewan.
Photo 3: Wild Rose Consulting, Inc.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Corydalis aurea* Willd. **Family:** *Fumariaceae*

Common Names: golden corydalis, golden smoke, scrambled eggs

***Corydalis aurea* blooms and green capsules on same plant.**

Plant Description

Winter annual or biennial herb with slender taproot; stems are mostly 10 to 30 cm tall, decumbent or ascending, glabrous and more or less glaucous, diffusely branched and leafy at base; leaves alternate, bipinnate, leaflets pinnatifid; flowers golden yellow racemes, corolla 1.2 to 1.5 cm long, the spur 0.5 cm long; capsules loosely spreading or pendent, more or less constricted and cylindric (Moss 1983).

Fruit: Capsules.

Seed: Shining, black, 0.2 cm diameter (Moss 1983).

Habitat and Distribution

Open woods, clearings and shores (Moss 1983). Often found on disturbed sites (Matthews 1993).

Seral Stage: Early obligate (Matthews 1993).

Soil: Moist to dry, well-drained rocky or sandy soil (Matthews 1993).

Distribution: Throughout Alberta. Alaska, Yukon to southwestern District of Mackenzie to northern Manitoba, northern Ontario, Quebec south to California, Texas, Missouri, Louisiana, Ohio, Vermont (Moss 1983).

Phenology

Indeterminate – flowers May through September (Lady Bird Johnson Wildflower Center 2011).

Pollination

Insect pollinated (Lady Bird Johnson Wildflower Center 2011).

Seed Dispersal

Ants and wind (Hanzawa 1985, Hanzawa et al. 1988, Matthews 1993).

Single flower of *Corydalis aurea*.

Genetics

2n=16 (Moss 1983).

Symbiosis
None known.

Seed Processing
Collection: Stems can be snipped and stored in breathable bags prior to hanging or drying.
Seed Weight: 1.09 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: Late July or August (Lady Bird Johnson Wildflower Center 2011).
Cleaning: Air-dry seeds in paper or Tyvek bags at 15 to 25ºC. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens (Matthews 1993).
Storage Behaviour: Likely orthodox.
Storage: Store cool and dry (Matthews 1993).
Longevity: May be long lived up to 160 years (Matthews 1993). Seeds in soil seed banks may live for decades or centuries until disturbance (Mackinnon et al. 2009).

Propagation
Natural Regeneration: Naturally regenerates from seeds (Matthews 1993).
Direct Seeding: Surface sow in the spring (Plants for a Future 2011).
Micro-propagation: Tissue culture has been successful in some species of *Corydalis*.

Aboriginal/Food Uses
Medicinal: Tea used for painful menstruation, backache, diarrhoea, bronchitis, heart diseases, sore throat and stomach aches. Smoke from burning roots could be inhaled for headaches (Lady Bird Johnson Wildflower Center 2011).
Used medicinally for a variety of ailments, including rheumatism, diarrhoea, sores on the hands, stomach aches, menstrual problems, and sore throats, and as a general disinfectant (eFloras.org, n.d.).
However, may be toxic (Lady Bird Johnson Wildflower Center 2011, Plants for a Future n.d.).

Wildlife/Forage Usage
Unpalatable, with poor value of content and produces poisonous alkaloids (Mathews 1993). Some poisoning of cattle and sheep has been reported (Mackinnon et al. 2009).

Reclamation Potential
An early seral species, *Corydalis aurea* would likely be easy to establish on freshly disturbed sites and would die off once the plant community stabilizes (Mackinnon et al. 2009, Matthews 1993).

Notes
Synonym *Capnoides aureum* (Willd.) Kuntze (ITIS n.d., Matthews 1993).

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Scientific Name: *Cypripedium acaule* Aiton **Family:** Orchidaceae

Common Name: moccasin flower, pink lady's slipper, pink lady's-slipper orchid, pink moccasin flower, stemless lady's slipper

Plant Description

An erect perennial forb; flowering stem leafless, pubescent, 10 to 30 cm tall; two elliptical to oval opposite basal leaves with parallel veins, sparsely pubescent, 10 to 20 cm long; pink (rarely white) solitary flower, fragrant, 3 to 6 cm long, with lanceolate yellow-green to greenish-brown sepals and lateral petals and large pink lower petal in a showy slipper or pouch with reddish venation and a longitudinal fissure (Moss 1983, Royer and Dickinson 2007).

Fruit: Brown, ribbed, ellipsoid capsule, 3 to 4.5 cm long (Brackley 1985).

Seed: 10,000 to 20,000 tiny seeds without endosperm are dispersed by wind (Cullina 2000).

Habitat and Distribution

Found in dry or damp sandy woods, bogs, swamps, slopes and roadsides on acidic soil (Moss 1983, Royer and Dickinson 2007) in partial to full sun (Davis 1986).

Seral Stage: Late

Soil: Acidic, well-drained sandy soils (Brackley 1985, Stuckey 1967, US Forest Service 2010).

Distribution: Found in eastern North America (USDA NRCS n.d.); in Canada along the Canadian Shield and in the northeastern corner Alberta (Royer and Dickinson 2007).

Western District of Mackenzie, northern Saskatchewan east to Labrador, Newfoundland south to the Great Lakes, Appalachia (Moss 1983).

Phenology

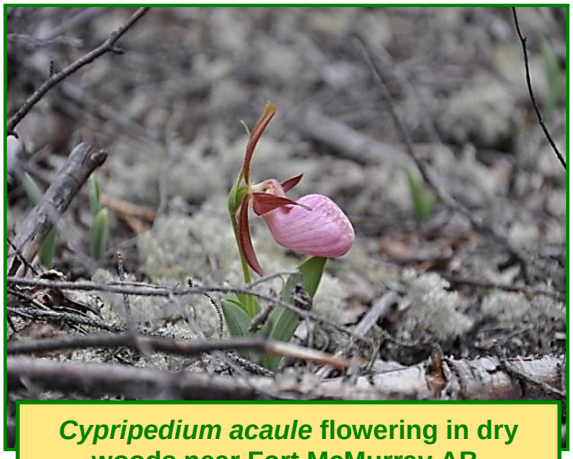
Flower in Alberta in late May to mid-June. Seeds appear early in July and ripen towards the end of July.

Illustrations of all stages from seed to seedling are included in Curtis (1943).

Pollination

Pollinators, primarily bees (*Bombus* spp.), enter through the central fissure in the lower petal but cannot exit the same way and thus must pass through the base of the flower, at which time a pollen mass from either anther attaches to the thorax. However, there is no nectar reward for pollinators (deceptive pollination), which may lead to lower pollination rates as pollinators learn to avoid such flowers (Davis 1986).

Hand pollination results in 70% to 75% (Davis 1986) and up to 100% (O'Connell and Johnston 1998) of plants producing fruit.



***Cypripedium acaule* flowering in dry woods near Fort McMurray AB.**

Seed Dispersal

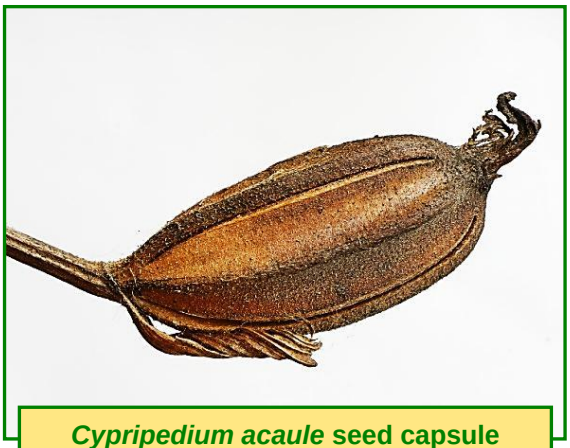
Microsperm can be wind dispersed when capsule dries.

Genetics

2n=20 (Moss 1983).

Symbiosis

For natural regeneration, *Rhizoctonia* spp. mycorrhizae are essential for germination because the fungus breaks open the seed and provide nutrients to the protocorm as it matures over several years (Durkee 2000, US Forest Service 2010).



***Cypripedium acaule* seed capsule**

Seed Processing

Collection: Seeds collected 60 days after pollination had 79% germination rate after four to five months (St-Arnaud et al. 1992).

Seed Weight: 0.0030 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Average Seed/Fruit: May range from 14,000 to 54,000 seeds per capsule (Davis 1986).

Harvest Dates: Leroux et al. (1997) collected in August. Capsules may be collected in late July in northeastern Alberta.

Cleaning: Leroux et al. (1997) rinsed the capsules in running water and lightly brushed them. The capsules were then washed in 70% ethanol for 1 minute, sterilized in 0.6 sodium hypochlorite solution for 40 minutes and rinsed three times with sterile water.

Storage Behaviour: Likely orthodox (Hong et al. 1998).

Storage: Seed survive dry freezing in vacuum; also stored over calcium chloride at 8°C (Hong et al. 1998).

Longevity: Loss in viability recorded after 4 years over calcium chloride (Hong et al. 1998).

Propagation

Natural Regeneration: Mostly by seed but vegetative propagation is possible. *C. acaule* has a long, complex lifecycle, including a below-ground stage called a protocorm, and may take 8 to 10 years for the first flowering (Curtis 1943). From seed to mature plant can take several years, and these plants may live for up to 20 years (US Forest Service 2010).

C. acaule may be sensitive to disturbance such as clear-cutting, at least in the short-term (Roberts and Zhu 2002) and may respond morphologically (e.g., lower leaf length and number of inflorescences) to increased foot traffic (Bratton 1985). They may benefit from fire (Stuckey 1967).

Germination: Germination requires *Rhizoctonia* spp. to break open the seed (US Forest Service 2010), although Durkee (2000) maintains that *C. acaule* can be grown in plastic containers in very acidic and nutrient poor soils.

Germination potential may be dependent on the physiological age of the seed, and planting immature seed may bypass dormancy of mature seed (St-Arnaud et al. 1992): best time to collect seed is 60 days after pollination (Rännbäck 2007).

Best germination temperature is <20°C (Rännbäck 2007).

Pre-treatment: *Cypripedium* spp. need a cold stratification to germinate (Rännbäck 2007, Smreciu and Currah 1989). Application of exogenous cytokinin can reduce the length of cold stratification; possibly eliminate the need for it completely (Rännbäck, 2007).

Scarification and sterilization *in vitro* by using hypochlorites, helps to break dormancy by breaking water repellent testa on orchid seeds (Rännbäck 2007). $Ca(OCl_2)$ is preferred over $Na(OCl_2)$, they

both can be applied from 0.2% to 5% concentrations (Rännbäck 2007).
Direct Seeding: No literature found.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: Do not survive transplanting (MacKinnon et al. 2009).
Micro-propagation: Protocols exist for propagation of other *Cypripedium* species.

Aboriginal/Food Uses

Medicinal: Used by the Algonquin, Iroquois, Mi'kmaq and Cree as a decoction for pains over the skin and as a poultice on bites from rabid dogs. *Cypripedium* species are known for their sedative, antispasmodic and tonic properties due to a compound called cypripedin in the rhizomes, which can be used to treat menstrual disorders, headaches and insomnia. It was also used to promote sleep and to relieve restlessness, hysteria and epilepsy (MacKinnon et al. 2009).
Other: Has promise as an herbal medicine as well as an ornamental flower, but it is not easily cultivated commercially nor does survive harvest from the wild (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Likely eaten by rabbits and deer (Stuckey 1967).
Livestock: Unknown.
Grazing Response: Possible decreaser.

Reclamation Potential

Notoriously difficult to cultivate or transplant; however, *C. acaule* does well in acidic nutrient poor soils (Durkee 2000).

Commercial Resources

Availability: Not available for commercial usage (Marles et al. 2000).
Cultivars: No literature found.
Uses: No literature found.

Notes

Synonyms include *Fissipes acaulis* (Aiton) Small, which is not valid (ITIS n.d.), and a variation, *C. acaule var. alba* (may not be valid), has a white lower petal.

Photo Credits

Photo 1: Wild Rose Consulting, Inc. 2011.
Photo 2: Will Milne - Native Orchid Conservation Inc. 2011.

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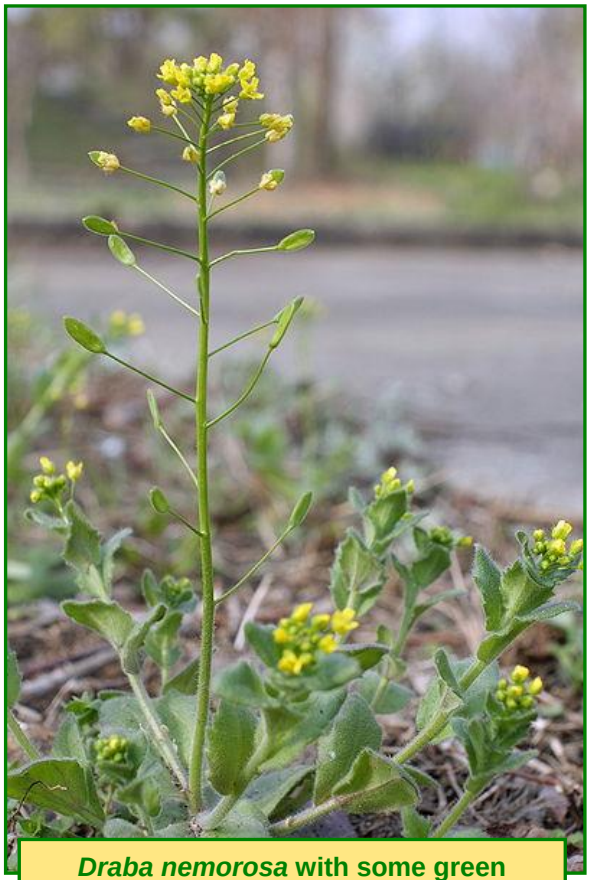
Scientific Name: *Draba nemorosa* L. **Family:** *Brassicaceae*

Common Names: woodland draba

Plant Description

Annual herb. Stems are mostly 3 to 35 cm tall with simple and forked hairs; leaves near-basal (bottom third of stem), 2 to 45 mm by 1 to 20 mm, ovate-lanceolate to obovate, denticulate, simple with few long stalked bifid and trifid cruciform hairs above and mostly long-stalked cruciform hairs below; raceme open, flowers yellow, 10 to 15 per raceme; sepals 2 mm long, glabrous or with simple hairs; petals 2 to 4 mm long, yellow (Moss 1983).
Fruit: 3 to 6 mm long (1 to 2 mm wide) elliptic glabrous or pubescent dehiscent silicle; seeds in two rows.



***Draba nemorosa* with some green silicles.**

Seed: Seed are light brown, 0.5 mm long, 0.3 mm wide, ovoid (Moss 1983).

Habitat and Distribution

Moist to dry open ground (Moss 1983). Rock outcrops, open wooded slopes, meadows and prairies, stream banks, roadsides, disturbed gravelly grounds, waste places (eFloras.org n.d.).
Seral Stage: Early.
Soil: Disturbed soils.
Distribution: Throughout Alberta. More or less circumpolar. Southern Alaska, southern Yukon, southern District of Mackenzie to Hudson Bay, southwestern Quebec south to California, Colorado, Nebraska, Minnesota (Moss 1983).

Phenology

Blooms in mid to late summer.

Pollination

Insect pollinated (Plants for a Future n.d.).

Genetics

2n=16 (Moss 1983).

Symbiosis

None known.

Seed Processing

Collection: Seeds can be handpicked by snipping or breaking stems into bags. Allow pods to dry on plant; break open to collect seeds (Dave's Garden n.d.).
Seed Weight: 0.03 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: Unknown, possibly August.
Cleaning: Air-dry seeds in paper or Tyvek bags at 15 to 25ºC. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens.

Storage: Store frozen in hermetically sealed containers after dry (Royal Botanic Gardens Kew 2008).
Storage Behaviour: Orthodox, seed can be dried to 3% to 7% relative humidity and stored at freezing temperatures (Royal Botanic Gardens Kew 2008).
Longevity: Possibly long term with ultra-dry seed (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: Naturally regenerates from seeds.
Germination: 85% germination in 1% agar media in temperatures of 25°C for 8 hour day and 10°C 12 hour night with pre-treatments (Royal Botanic Gardens Kew 2008).
Pre-treatment: Seed was scarified by chipping with a scalpel (Royal Botanic Gardens Kew 2008). Stratification suggested for indoor seeding (Dave's Garden n.d.).

Aboriginal/Food Uses

Food: No literature found.
Medicinal: No literature found.
Other: No literature found.

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: Poor forage for all *Draba sp.* (Tannas 2004).
Grazing Response: Increaser (Tannas 2004).

Commercial Resources

Availability: No literature found.
Cultivars: No literature found.
Uses: No literature found.

Reclamation Potential

An early seral species, *Draba nemorosa* would likely be easy to establish on freshly disturbed sites. Suggested for xeriscaping (Dave's Garden n.d.).

Notes

Requires both the flowers and fruit for proper identification (Tannas 2004).

Photo Credits

Photo 1: Dalgial. 2010. Wikimedia Commons.

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Scientific Name: *Drosera rotundifolia* L. **Family:** *Droseraceae*

Common Names: round-leaved sundew

***Drosera rotundifolia* leaves with sticky insectivorous leaves.**

Plant Description

Insectivorous, flowering stems10 to 20 cm in a rosette of 4 to 12 leaves; round, basal leaves, 3 to 10 cm long, 6 to 10 mm across, covered with sticky red hairs; raceme flower cluster, 3 to 10 flowered; flowers are white with 5 sepal, 5 petals, 4 to 8 stamens and 1 pistil (Royer and Dickinson 2007).
Fruit: Capsule that splits into 3 sections, 3 to 5 mm long that contains many seeds (Crowder et al. 1990, Royer and Dickinson 2007).
Seed: Numerous, small, smooth dark brown and spindle shaped (Crowder et al. 1990, Moss 1983).

Habitat and Distribution

Swamps and bogs (Moss 1983). It is almost always associated with sphagnum moss (Lahring 2003). Shade intolerant (Matthews 1994).
Seral Stage: Mid to late seral (Matthews 1994).
Soil: Prefers low nutrient environments and can tolerate very acidic soils (pH 3.2 to 7.3); no tolerance to salt (International Carnivorous Plant Society 2006, Lahring 2003, Matthews 1994).
Distribution: Circumpolar. Alaska, Yukon, District of Mackenzie to Hudson Bay, Newfoundland south to California, Nevada, Idaho, Montana, New Dakota, Great Lakes, Appalachians, Alabama, Florida (Moss 1983).

Phenology

Flowers bloom from June to September only during the day, one per day starting from the bottom of the inflorescence (flowers are indeterminate). The flowers self-pollinate during the night (Matthews 1994).
Seeds start to appear in July and ripen successively into the late fall (Matthews 1994).

Pollination

By insects or wind (Matthews 1994).

Seed Dispersal

Water and possibly wind and birds (Crowder et al. 1990).

***Drosera rotundifolia* flower**

Genetics

2n=20 (Moss 1983).

Symbiosis

Vesicular mycorrhiza reported (Crowder et al. 1990).

Seed Processing

Collection: Cut the flower stalk off at the base when the stalk is completely brown. Be aware that seed at this stage will start to rot if left too long (May n.d.).
Seed Weight: 0.02 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: Seeds are indeterminate and can be harvested in late summer and into the fall (Matthews 1994).
Cleaning: Seed can be cleaned using fine screens (International Carnivorous Plant Society 2006).
Storage Behaviour: Possibly orthodox (Royal Botanic Gardens Kew 2008).
Storage: *Drosera* ssp. seed has remained viable up to 10 years stored at temperatures around 4 to 5°C (May n.d.).
Longevity: Seeds were found to survive 1 to 5 years in the soil seed bank (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: Reproduces vegetatively by the production of plantlets or when axillary buds below ground begin to produce a second rosette (Matthews 1994).
Also reproduces through seed (Matthews 1994).
Germination: 1 to 2 months after sowing in temperatures of 20°C (Plants for a Future n.d.). Plants require light to germinate (do not bury the seed in the soil) (May n.d.).
Germination can take anywhere from 2 to 7 weeks depending on the age of the seed (May n.d.).
Seeds achieved 100% germination when germinated on 1% agar with 250 mg/L gibberellic acid at 20°C (8 hours/day 16 night) with pre-treatments (Royal Botanic Gardens Kew 2008).
84% germination was reached when seed was sown on 1% agar and 101 mg/L potassium nitrate at 20°C (8 day /16 night) with warm and cold stratification (Royal Botanic Gardens Kew 2008).
Long fibered or live sphagnum moss, coarse silica sand, and perlite for propagation (International Carnivorous Plant Society 2006).
Pre-treatment: Requires 2 to 6 weeks of cold stratification (May n.d.). Seed scarification may also assist germination (Royal Botanic Gardens Kew 2008).
Warm stratification at 20°C for 8 weeks and cold stratification at 5°C for eight 8 weeks on 1% agar (Royal Botanic Gardens Kew 2008).
Vegetative Propagation: *Drosera* sp. can be propagated from cuttings (Dave's Garden 2011).
Micro-propagation: Have been propagated by *in vitro* methods for commercial preproduction (Bobák et. al.1995).


***Drosera rotundifolia* catching a fly**

Aboriginal/Food Uses

Food: No literature found.
Medicinal: Used to treat many respiratory disorders including asthma and tuberculosis, sooth sore throats and cough. *D. rotundifolia* is believed to have an anti-inflammatory, antispasmodic, antibacterial and anti-angiogenic properties. Used to treat warts and corns (MacKinnon et al. 2009).

Wildlife/Forage Usage

Wildlife: Eaten before they flower by moose (Matthews 1994).
Livestock: No literature found.
Grazing Response: Unknown but it has been found in fields that have been grazed by both cattle and sheep (Matthews 1994).

Reclamation Potential

Drosera rotundifolia tolerates low nutrient conditions and prefers acidic soils. Wild Rose Consulting has

observed *Drosera* growing on hydrocarbon heavy soils in Fort McMurray.

Commercial Resources

Availability: No seed available for commercial use.
Cultivars: 'Charles Darwin' (International Carnivorous Plant Society 2006).
Uses: *D. rotundifolia* is used in 200 to 300 registered medications in Europe, mostly cough medicines (MacKinnon et al. 2009). Also a homeopathic remedy for a variety of ailments (abc Homeopathy n.d.).
Is used to curdle milk to make cheese in Sweden (Mackinnon et al. 2009).

Notes

D. rotundifolia is listed as 96% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Is a carnivorous plant and relies on small crawling insects, such as ants and springtails, as well as *Diptera* spp. to supplement the nutrients that the plant gets from the soil (Krafft and Handel 1991).

Photo Credits

Photo 1&2: Bill Bouton @ flickr 2012.
Photo 3: i- saint @ flickr 2012.

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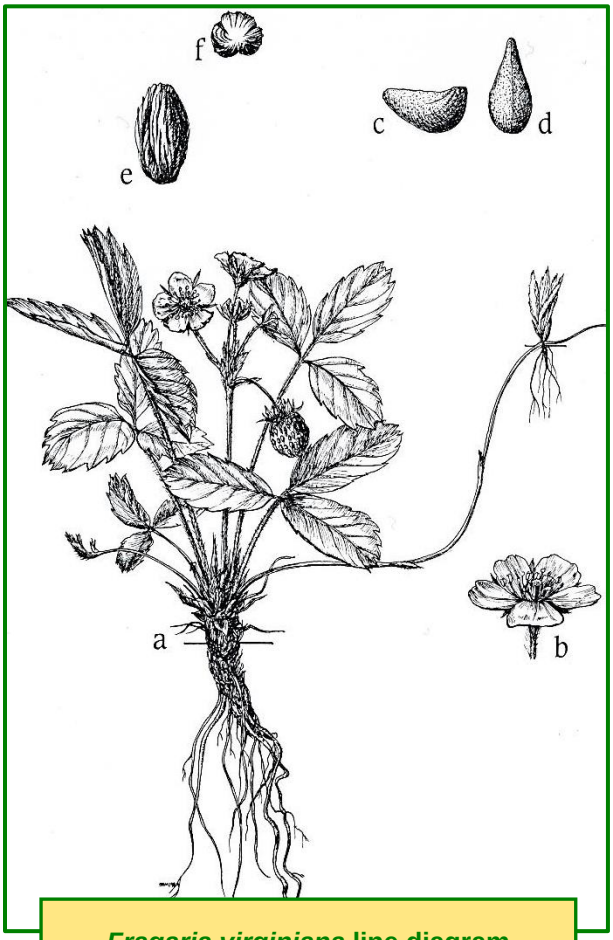
Scientific Name: *Fragaria virginiana* ssp. *glauca* (S.Wats) Staudt.
Family: *Rosaceae*

Common Names: wild strawberry, Virginia strawberry



***Fragaria virginiana* line diagram**
a. crown b. flower c & d seed
e & f pollen

Plant Description

Low growing perennial herb, stems up to 15 cm long from short, scaly rhizomes producing long slender stolons which root and form new plants; basal leaves, 2 to 7 cm long, long-petioled, trifoliate, coarsely toothed, terminal tooth usually shorter than the two adjacent lateral teeth, bluish green above and often rounded at the base; small white flowers, 2 to 15 in open clusters, five petals, 6 to 8 mm long (Moss 1983).

Fruit: Tiny achenes sunken in a fleshy red berry (Moss 1983).
Seed: Round, tear shaped, light brown, 1 mm long (Moss 1983).

Habitat and Distribution

Common in depressional areas and moist coulees in prairie region, dry to moist open woods, meadows, clearings and often in disturbed areas.
Seral Stage: Early. Ubiquitous on recently disturbed sites.
Soils: Wet to mesic soil moisture (Gerling et al. 1996).
Prefers pH of 5.3 to 6.0 (Jett 2005).
Distribution: Widespread across Alberta. Alaska, Yukon, western District of Mackenzie to Hudson Bay, Newfoundland south to California, Colorado, Oklahoma, Tennessee, Georgia (Moss 1983).

Phenology

Bud initiation takes place in autumn with declining photoperiods. Flower buds appear from mid April to late May. Flowers May to June. Stolon production occurs from early May to August (Jurik 1985). Fruit ripens by late June to July.

***Fragaria virginiana* flower.**

Pollination

Wild strawberry is pollinated by a wide variety of small generalist bees (Apidae, Halicidae, Anthophoridae, Andrenidae and Megachilidae), several species of flies (Syrphidae, Bombyliidae, and Conopidae) and ants (Formicidae) (Ashman 2000).

Seed Dispersal

Fragaria sp. are likely spread by birds and mammals (Munger 2006).

***Fragaria virginiana* berry.**

Genetics

2n=56 (Moss 1983).

Symbiosis

Is host of the root endophytic fungus *Phialocephala fortinii* (Addy et al. 2000).

Seed Processing

Collection: Primarily by hand. Carry berries in plastic buckets.

Seed Weight: 0.3717 g/1,000 seeds.
Fruit/Seed Volume: 2,368 fruit/L (70,400 seeds/L fruit).
Fruit/Seed Weight: 3,939 fruit/kg (118,000 seed/ kg).
Average Seeds/fruit: 32 seeds/fruit.
Harvest Dates: Late July.
Cleaning: Place pulpy fruit in water (use about 3:1 water with fruit) and place in a blender on low speed until fruit are fully macerated. Pour through sieve(s) to remove chaff smaller than seeds. Re-suspend residue in water and mix. Allow seeds to settle and decant water with floating and suspended larger chaff. Repeat re-suspension step until seeds are clean. Sieve and place seeds on paper toweling or cloths to dry. Dry at room temperature or up to 25°C over a moving air stream.
Storage Behaviour: Orthodox, seeds may be dried to 3% to 7% relative humidity and stored frozen (Royal Botanic Gardens Kew 2008).
Storage: 75% viability following drying to moisture content's in equilibrium with 15% relative humidity and freezing for 107 days at -20°C (Royal Botanic Gardens Kew 2008).
Longevity: When stored in sealed containers the seeds can remain viable for up to 20 years (Rose et al. 1998).

Propagation

Natural Regeneration: Spreads by short rhizomes (Anderson and Roderick 2006). Reproduces primarily by stolons and at a lesser extent by seeds (Gerling et al. 1996).
Germination: Greater than 70% germination after 30 days, with fresh and one year old seeds from northeastern Alberta.
75% to 95% germination was achieved at varying temperatures on a 1% agar media (Royal Botanic Gardens Kew 2008).
Pre-treatment: None required, germinate readily. Rose et al. (1998) recommend 2 to 3 months cold stratification with exposure to light.
Direct Seeding: Up to 5% emergence of seedlings after two growing seasons (Smreciu et al. 2006).

Seeds of wild strawberry – generally about 1 mm long.

Vegetative Propagation: In the fall, plant runners or plantlets in pots in a sheltered place with constant moisture; in late winter or early spring, plant seedlings outdoors in full sun, in a light loose soil, 25 cm apart (Anderson and Roderick 2006). Wild strawberry grown from root cuttings in styroblock containers had a 60% to 80% survival rate and was spreading the first growing season in the landfill revegetation study carried out by Smreciu and Barron (1997).

Cut newly rooted runners with at least two nodes from the parent plant and treat basal end with a mild strength rooting hormone and plant in perlite: vermiculite (1:1) medium and place on a mist bench at 20°C (Rose et al. 1998).

Aboriginal/Food Uses

Food: Wild strawberry is a very important fruit. They can be eaten fresh or preserved, can be frozen, dried or made into jams and jellies (Duke 1992, Marles et al. 2000). They contain more vitamin C than an equal weight of oranges (Kindscher 1987).

Medicinal: The whole plant, the leaves, or roots were boiled and used as a decoction to treat heart conditions. The roots, leaves, and runners were boiled and the decoction was drunk to treat diarrhoea and dysentery. Strawberry leaf tea, using completely dried leaves, was used as a wash to treat sores, eczema and other skin problems (Duke 1992, Gray 2011, Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Poor forage value. Used to some extent by elk and deer (Tannas 1997). The fruit and leaves are eaten by small mammals and birds (Anderson and Roderick 2006).

Livestock: Poor forage value, low palatability (Gerling et al. 1996, Hale et al. 2005). Used to a small extent by sheep (Tannas 1997).

Grazing Response: Increaser, very resistant to heavy grazing and trampling (Tannas 1997), often covering the ground where grazing pressure has removed more favourable species (Hale et al. 2005).

Reclamation Potential

F. virginiana is a pioneer plant on disturbed lands. The abundant production and rapid spread of its runners makes it an important plant for soil stabilization while climax species establish.

It has great potential for increased ground cover with its long stolons, trailing stems, or root sprouts.

Wild strawberries can be transplanted in early spring (Kindscher 1987).

Fragaria is highly susceptible to damage caused by sodium and sulfate enriched consolidated tailings water (Renault et al. 1998).

Commercial Resources

Availability: Available commercially at various sources in Alberta (ANPC 2010).

Cultivars: Numerous horticultural cultivars are available but these are not suitable for reclamation plantings.

Uses: Aromatherapy (essential oil) (Marles et al. 2000).

Notes

Fragaria virginiana is listed as 92% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Exhibits aggressive growth (Gerling et al. 1996). In their study, Holler and Abrahamson (1977) suggest that wild strawberries under high population density conditions (increased competition) will exhibit a decrease in vegetative reproduction and an increase in seed production. This encourages dispersal to new and possibly more favourable sites. In low population density conditions, the vegetative reproduction of wild strawberries will increase to ensure local spread.

Photo Credits

Photo 1: Glen Lee, Regina, Saskatchewan.
Photo 2: Wild Rose Consulting, Inc.
Photo 3: Shannon Hammonds, Kamloops, British Columbia.
Line diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Galium boreale* L. **Family:** *Rubiaceae*

Common Names: northern bedstraw, sweet scented bedstraw, fragrant bedstraw

***Galium boreale* line drawing.**

Plant Description

Erect widely distributed perennial forb; slim stems from 20 to 80 cm with linear-lanceolate leaves in whorls of 4.1 to 6.5 cm long by 2 to 12 mm wide, 3-veined and blunt; inconspicuously hairy fruit with a diameter of 2 mm (Gucker 2005). Numerous 4-petaled showy flowers of white to cream colour forming in clusters of 3 at stem tips (Moss 1983).
Fruit: Glabrous to inconspicuously white haired nutlets, 2 mm in diameter (Gucker 2005).
Seed: Large amounts produced, have a barbed seed coat (Robb pers. comm.).

Habitat and Distribution

Common in moist woods, clearings, roadsides and spread widely across Canada and the United States. Tolerant of a wide range of climates (Gucker 2005). Often pioneering in disturbed soils (CYSIP: Botany n.d.).
Seral Stage: Variable, early to late.
Soil: Tolerant of a wide pH range but prefers moist well drained soils (Gucker 2005). Prefers moderate to coarse textured soils, with moderate drought tolerance, no salinity tolerance and no anaerobic tolerance (USDA NRCS n.d.).
Distribution: Circumpolar. Alaska, Yukon, southwestern District of Mackenzie to Hudson Bay, southern Quebec south to California, Texas, Missouri, Ohio, Delaware (Moss 1983).

Phenology

Flowers from May to September depending on the region (Gucker 2005).

Pollination

Insect pollinated (Gucker 2005).

Seed Dispersal

Hooked barbs on seed attach to passing animals (Gucker 2005).

Genetics

2n=22, 44, 55, 66 (Moss 1983).

Symbiosis

No literature found.

Seed Processing

Collection: Collect the seed head and store in a paper bag until processing.
Seed Weight: 0.405 g/1,000 seeds (USDA NRCS n.d.)

0.6 g/1,000 seeds (Gucker 2005).
Harvest Dates: End of July to early August, though it does not drop its seed right away so seed may be collected through to September.
Cleaning: Run the seeds through a sieve to break up dirt and seed or rub seed with gloved hands (Robb pers. comm.).
Storage Behaviour: Likely orthodox; dry prior to cold storage.
Storage: 26% viability was retained when seeds were stored at 15% moisture content at temperatures of -20°C for 7 months (Royal Botanic Gardens Kew 2008). Cool dry storage (Prairie Moon Nursery n.d.).
Longevity: Is a short lived species living less than a year in the soil seed bank (Royal Botanic Gardens Kew 2008).

***Galium boreale* in bloom**

Propagation

Natural Regeneration: Rhizomatous asexual reproduction is most common, in guerrilla clonal growth form (Gucker 2005). Vegetative germination is its primary method of reproduction but also produces seed.
Germination: No literature found.
Pre-treatment: No pre-treatment necessary (Prairie Moon Nursery n.d.).
Direct Seeding: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: No literature found.

Aboriginal/Food Uses

Food: Roots and leaves boiled in teas. *G. boreale* seeds sometimes used as a ground as a coffee substitute (Plants for a Future 2012, Tannas 2004). Young plants can be eaten as a cooked green; one change of water eliminates bitterness (CYSIP: Botany n.d.).
Medicinal: Used in a poultice for general treatment of aches and pains or combined with butter as a salve. Mixed into tea to treat cold and flu symptoms (Gucker 2005).
Stimulates urination and was used to treat bladder infections or kidney stones (CYSIP: Botany n.d., Johnson et al. 2005).
Other: A red dye can be made from the roots (often combined with cranberries) and flowers were used as a perfume (CYSIP: Botany n.d., Tannas 2004).
Used as stuffing material for beds (CYSIP: Botany n.d., Plants for a Future 2012).

Wildlife/Forage Usage

Wildlife: Not common as a nutrient for ungulates, Black bear and ground foraging birds consume more (Gucker 2005).
Plants contribute to habitat for big game and rodents (Gucker 2005).
Livestock: Poor; sometimes consumed by sheep (Tannas 2004).
Grazing Response: Increaser (Tannas 2004).

Reclamation Potential

Successful after transplantation; a sod re-location method was performed (Gucker 2005). Purdy et al. (2005) found populations of *G. boreale* to be frequent and moderately abundant in dry saline habitats while others have noted it as being a common forb in other boreal forest saline areas.

It has also found to have value for soil stabilization because it spreads by rhizomes (Tannas 2004).

Commercial Resources

Availability: Is available for landscaping use in a few nurseries in Alberta. Locally collected seed is recommended for reclamation.
Cultivars: No literature found.
Uses: No literature found.

Notes

Galium boreale is listed as 86% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Colin Stone.
Line Diagram: USDA-NRCS PLANTS 2011.

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Scientific Name: *Geranium bicknellii* Britt. **Family:** *Geraniaceae*

Common Names: Bicknell's geranium, Bicknell's cranesbill

***Geranium bicknellii* blooms and green fruit.**

Plant Description

Annual or biennial herb with a slender taproot, usually much branched; stems are mostly 20 to 60 cm tall with spreading hairs and sometimes glandular above; leaves 2 to 7 cm broad, deeply 5-parted, the cuneate divisions cleft into several narrowly oblong lobes; peduncles 2 flowered, pedicels distinctly longer than calyx and glandular-villose; sepals awn-tipped, hairy on margins and veins; petals rose-purple, 5 to 7 mm long, slightly longer than sepals (Moss 1983).

Seed: Mature fruit about 2 cm long with 3 to 5 mm long filiform beak. Seeds cylindrical with network of areolae (Moss 1983).

Habitat and Distribution

Clearings, open woods, disturbed soil (Moss 1983). Shade intolerant (Plants for a Future n.d.).

Seral Stage: Early to late (Reeves 2007).

Soil: Recently disturbed (Reeves 2007).

Distribution: Throughout Alberta. Alaska, Yukon, southwestern District of Mackenzie to James Bay, Nova Scotia, Newfoundland south to California, Utah, Colorado, South Dakota, Iowa, Indiana, Massachusetts (Moss 1983).

Phenology

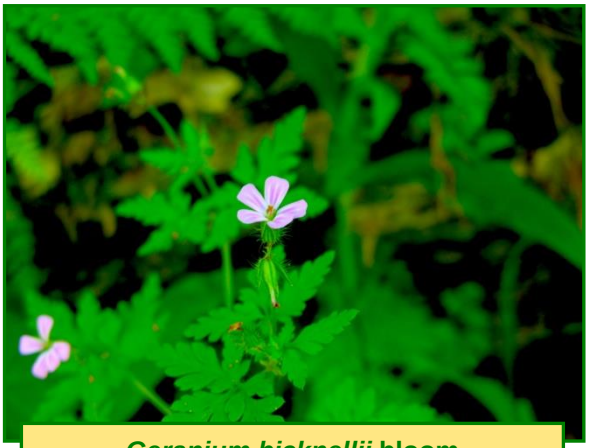
Blooms June through August; indeterminate growth (Lady Bird Johnson Wildflower Centre 2012). Flowering in southeastern Canada is May to September (Reeves 2007).

Pollination

Insect pollinated (Lady Bird Johnson Wildflower Centre 2012).

Seed Dispersal

The seed capsules dry and explode, flinging seeds away from the parent plant; seed can be carried by small animals to a different location (Reeves 2007).



***Geranium bicknellii* bloom**

Symbiosis

Other species of *Geranium* form vesicular-arbuscular associations with mycorrhiza.

Seed Processing

Collection: Seeds can be hand-picked into bags.
Seed Weight: 1.84 g/1,000 (Royal Botanic Gardens Kew 2008).
Harvest Dates: August and September.
Cleaning: Air-dry seeds in paper or Tyvek bags at 15 to 25ºC. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens.
Storage: Store cool and dry (Reeves 2007).
Longevity: Is long lived in soil seed bank (Reeves 2007). Seeds 200 years old and older have been found in the soil however the viability of the seed was unknown (Reeves 2007).

Propagation

Natural Regeneration: Naturally regenerates primarily from seeds (Reeves 2007).
Germination: Optimum germination temperature is 20ºC (Baskin and Baskin 2001).
Pre-treatment: 90% germination when exposed to heat for 10 minutes at 65 to 100°C (Baskin and Baskin 2002, Reeves 2007).
No stratification required (Baskin and Baskin 2001).
Direct Seeding: No literature found.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: No literature found.
Micro-propagation: No literature found.

Aboriginal/Food Uses

Medicinal: Tea was gargled to heal mouth sores and sore throats (Plants for a Future n.d.) or swallowed to treat urinary infections, excessive menstruation, diarrhoea and intestinal diseases (e.g., cholera and dysentery) (Johnson et al. 1995).

Reclamation Potential

An early seral species, *Geranium bicknellii* would establish well on freshly disturbed sites (Tannas 2004).

Notes

Geranium bicknellii is listed as 98% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Seeds have been found to germinate after fire or on disturbed sites where the soil warms due to an open canopy (Baskin and Baskin 2001, Reeves 2007).

Photo Credits

Photo 1: Jacob Enos, used with permission.
Photo 2: E. vander Pijil. Wikimedia commons.

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Tannas, K., 2004. Common plants of the western rangelands. Volume 3: Forbs. Olds College, Olds, Alberta and Alberta Agriculture, Food and Rural Development, Edmonton, Alberta. 505 pp.

Scientific Name: *Geum rivale* L. **Family:** *Rosaceae*

Common Names: purple avens, water avens, chocolate-root

Line diagram of *Geum rivale*

Plant Description

Perennial herb 40 to 100 cm tall, hairy; root stock short. Basal leaves 5 to 30 cm long, fiddle shaped, compound with 3 main leaflets; terminal leaflet somewhat 3-lobed with coarsely toothed margin and hairy surface. Raceme flower cluster with 2 to 4 flowers, borne in upper leaf axils. Flowers are pinkish purple, nodding, 15 to 20 mm across; 5 yellowish purple sepals and 5 petals pinkish yellow with purple veins with purple veins; stamens and pistils numerous (Royer and Dickinson 2007).
Seed: Achene with a strong hooked awn (Taylor 1997).

Habitat and Distribution

A wetland species (Taylor 1997), *G. riviale* is found on streambanks, in marshes and wet meadows (Moss 1983).
Seral Stage: Mid seral.
Soil: Fine to coarse textured soils with pH 4.8 to 7 (USDA NRCS n.d.).
No salinity tolerance (USDA NRCS n.d.).
Tolerant of periodic flooding (Taylor 1997).
Distribution: British Columbia to Newfoundland south to Washington, New Mexico, Missouri, Indiana, New Jersey (Moss 1983).

Phenology

In flower May to September and produces seeds June through October (Plants for a Future n.d.).
Plants can flower 2 to 7 years after germination depending on conditions and produce seed almost every year afterwards (Taylor 1997). Seeds then germinate in the spring of the following year (Taylor 1997).

Pollination

They are pollinated by insects as well as they can be self-pollinated (Plants for a Future n.d.).

Genetics

2n=42 (Moss 1983).

Symbiosis

Form some mycorrhizal associations with vesicular arbuscular (Taylor 1997).

Seed Processing

Collection: Harvest by hand. Barbed seeds are easily caught on cloth gloves and then rubbed free.
Seed Weight: 880 seeds/g (USDA NRCS n.d.).
1.01g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Average Seed/Fruit: One flowering head can produce 100 to 150 seeds (Taylor 1997).
Harvest Dates: Late July and August.
Cleaning: Seed can be extracted from chaff using cloth. Screens may also help separate seed from chaff.
Storage Behavior: Unknown, likely orthodox.
Storage: Store cold after drying to low relative humidity.
Longevity: Can be stored for up to one year.

Propagation

Natural Regeneration: By seed and vegetatively through caudex rhizome (Taylor 1997). *Geum rivale* reproduces mainly vegetatively and relies on seed to establish new populations of plants (Taylor 1997).
Germination: Germination is epigeal (Taylor 1997). 70% germination in laboratory at temperatures 20/15°C; germination rates remained similar after a year of dry storage (Taylor 1997).
100% germination achieved when seeds where tested on 1% agar with temperature treatments ranging from 15 to 25°C (Royal Botanic Gardens Kew 2008). Seedlings should be fully emerged from soil after two weeks (Taylor 1997).
Pre-treatment: None required.
Direct Seeding: No literature found.
Seed Rate: No literature found.
Seed Propagation: Sow seed in cold frame and pick out seedlings as they germinate into individual containers (Plants for a Future n.d.).
Vegetative Propagation: No literature found.
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: Roots can be boiled to make a chocolate like drink (Plants for a Future n.d.).
Medicinal: Root tea was drunk to facilitate childbirth; an extract of the whole plant is reported to have blood coagulant properties. Also have been known cause abortions and damage embryos in animals (Marles et al. 2000). Roots were boiled to for a steam bath to treat rheumatism (Mackinnon et al. 2009). The roots where used to treat spitting of blood, diarrhea, dysentery, coughs (especially in children), fevers, indigestion, hemorrhages, menstrual disorders, intestinal worms and stomach ulcers (Mackinnon et al. 2009).
Other: Can be used to repel moths in gardens (Plants for a Future n.d.). Crushed seeds were used as perfume (Mackinnon et al. 2009).

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: No literature found.
Grazing Response: Suppressed by grazing (Taylor 1997).

Reclamation Potential

It would be useful as erosion control for moist areas because it can reproduce somewhat aggressively by its rhizome.


Early bloom of *Geum rivale*

Commercial Resources

Availability: None known.
Cultivars: None known.
Uses: None known.

Notes

Geum rivale is listed as 97% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Will hybridize with members of the same species (Plants for a Future 2012).

Photo Credits

Photo: Kristian Peters, Wikimedia Commons 2006.
Line Diagram: Topjabot, Wikimedia Commons, 2004.

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Scientific Name: *Hedysarum alpinum L.* **Family:** *Fabaceae*

Common Names: alpine sweetvetch, alpine sweet broom, licorice root, sweetbroom

Plant Description

Cool season perennial, few to numerous ascending or erect stems, 20 to 70 cm tall, hairy with appressed hairs; stipules brown; from a woody caudex and taproot; leaves pinnate with 11 to 21 leaflets each 1 to 3 cm long, broadly-lanceolate to oblong, each with an abrupt short point; leaves smooth above, sparsely hairy beneath, conspicuously veined on both surfaces; flowers borne at the leaf axils, inflorescence a narrow raceme, pink to red-purple (Pahl and Smreciu 1999).

Fruit: Seed pod a flat loment, jointed, indehiscent or breaking between sections (Pahl and Smreciu 1999).

Seed: 3 mm long, brown to purple black, kidney shaped, smooth (Pahl and Smreciu 1999).

Habitat and Distribution

Moist, open woods and slopes, gravely banks to alpine and sub alpine elevations, roadsides and mesic to moist grasslands (Moss 1983, Pahl and Smreciu 1999).

Seral Stage: Found in early and late seral stages of succession (Pahl and Smreciu 1999).

Soil: Medium textured soils, with pH range 6 to 8 (USDA NRCS n.d.). *Hedysarum* spp. are alkaline tolerant and moderately drought tolerant (Hardy BBT Limited 1989).

Distribution: Alaska, Yukon, Banks Island, Victoria Island, northern District of Mackenzie to Hudson Bay, Newfoundland south to British Columbia, Montana, Wyoming, Saskatchewan, Manitoba, central Ontario, Vermont, Maine; South Dakota (Moss 1983).

Phenology

Flowering is indeterminate; they flower from late May to late September; seeds mature in the wild from mid-August to mid-September. In cultivation, seeds mature as early as late June (Pahl and Smreciu 1999).

***Hedysarum alpinum* plant in flower**

Pollination

Insects – bumblebees; often seeds are empty, possibly due to lack of pollinators (Pahl and Smreciu 1999).

Seed Distribution

Seed are scattered a short distance as dry fruits dehisce.

Genetics

2n=14, 28 (Pahl and Smreciu 1999).

Symbiosis

Associated with rhizobial bacteria as well as vesicular-arbuscular mycorrhizae (Pahl and Smreciu 1999).

***Hedysarum alpinum* plant with mature seeds**

Seed Processing

Collection: Expect the first significant seed crop in the third year after cultivation. Direct combining or swathing is recommended. For small lots and wild harvest: cut, bag, dry and thresh (Pahl and Smreciu 1999).

Seed Weight: 4.35 g/1,000 seeds (Pahl and Smreciu 1999). 200 PLS/g (Hammermeister 1998).

Harvest Dates: Late July to early September (Pahl and Smreciu 1999).

Cleaning: Must be debearded at time of seeding, and all leafy material removed from the seed using a coarse screen. Screen seed with a top screen 7 to 7.5/64' round screen and a bottom screen 1/15" round. Commercial *Hedysarum* species are successfully cleaned and dehulled using a beet decorticator (seed is also scarified) (Pahl and Smreciu 1999).

Storage Behaviour: Likely orthodox; seeds can be dried, without damage, to low moisture contents; longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).

Storage: Store dry at cool temperatures (Pahl and Smreciu 1999).

Longevity: Viability was reduced by 50% after five years of storage in ambient conditions (Royal Botanic Gardens Kew 2008).

Propagation

Natural Regeneration: By seeds and rhizomes (Gucker 2007).

Germination: 90% to 92% in 3 to 5 days with pre-treatment; 30% to 40% in 10 to 15 days without pre-treatment (Pahl and Smreciu 1999).
50% germination in greenhouse (Hardy BBT Limited 1989).

Pre-treatment: Scarification (Lady Bird Johnson Wildflower Center 2009). Mechanical scarification of seed lots is difficult due to varying degrees of hardness; seeds are often lost to breakage (Pahl and Smreciu 1999).

Direct Seeding: Row cropping 60 to 90 cm row spacing; seed in early fall or spring and plant at a depth of 0.6 to 0.9 cm (Pahl and Smreciu 1999).

Seed Rate: 80 to 100 seeds/linear metre of a row.

Vegetative Propagation: Stem (tip or internodal) cuttings in the spring (Pahl and Smreciu 1999).

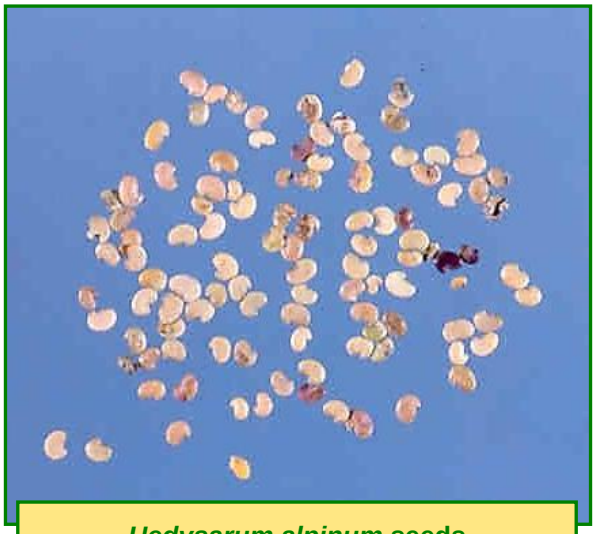
Aboriginal/Food Uses

Food: Roots were collected in spring and buried in caches or preserved in lard, oil or dried for winter use (Mackinnon et al. 2009).

Medicinal: Sun dried *Hedysarum alpinum* was burned and smoke was trapped with a blanket as a treatment for sore eyes. Roots are rich in vitamin C. Plant has anti-inflammatory, anti-viral and central nervous system stimulating properties (Mackinnon et al. 2009).

Other: Pieces of root softened by chewing were given to babies as pacifiers. Preserved roots were an

important trade item among some native tribes (Mackinnon et al. 2009).



***Hedysarum alpinum* seeds**

Wildlife/Forage Usage

Wildlife/Livestock: Moderately nutritious and palatable to all wildlife and all classes of livestock throughout most of the season (Tannas 1997).
Roots and stems are edible – bears and mice eat the plant (Hardy BBT Limited 1989); grizzly bears eat the roots (Tannas 1997, Turner 1997).
Grazing Response: Increaser in moderate to heavy grazing (Tannas 1997).

Reclamation Potential

Can colonize disturbed sites in the mountains and foothills. Is a pioneer species on roadsides (Pahl and Smreciu 1999).
Seeding of *H. alpinum* at Grande Cache resulted in little or no growth and on pipeline rights-of-way in northeastern British Columbia survival and germination varied from 3% on unstable and steep slopes with sandy soil to 10% on slopes with clay loam soils (Hardy BBT Limited 1989).

Photo Credits

Photo 1, 2 & 3: Wild Rose Consulting, Inc.

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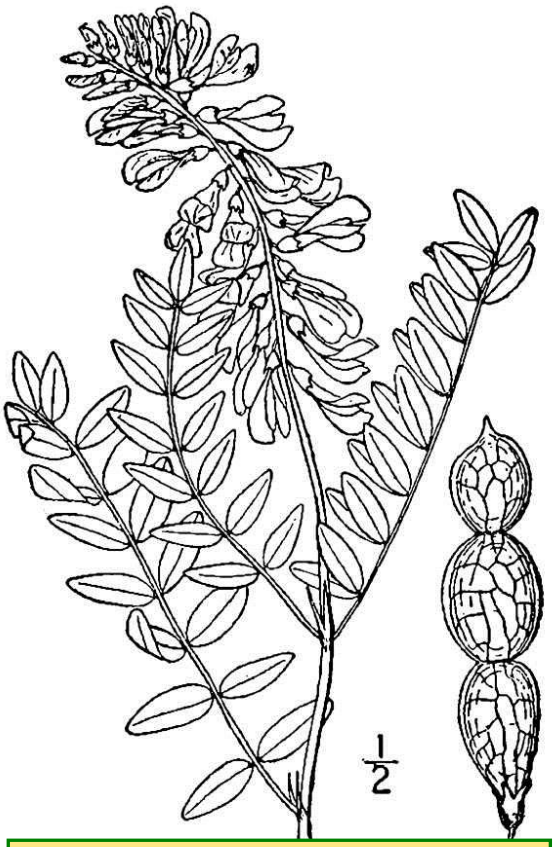
Scientific Name: *Hedysarum boreale* Nutt. **Family:** *Fabaceae*

Common Names: boreal sweet-vetch, boreal sweetvetch, northern sweetvetch, sweetvetch.



Line drawing showing raceme and seed pod of *H. boreale*

Plant Description

Perennial, stems ascending; leaves with 9 to 13 leaflets; leaflets with obscure veins, hairy (at least below); flower wings standard and keel similar in length; flowers in a dense, compact raceme, erect, red-purple to bright pink (Pahl and Smreciu 1999).
Fruit: Pubescent loments, segments not wing-margined (Pahl and Smreciu 1999).
Seed: 3 mm long, dark brown, kidney shaped, smooth (Pahl and Smreciu 1999).

Habitat and Distribution

Primarily a montane or alpine species in Alberta (to at least 2,100 m), but also scattered in the mixed grass prairie and occasionally in northern areas (Pahl and Smreciu 1999).
Seral Stage: Found in both early and late stages of succession (Pahl and Smreciu 1999).
Soil: Adapted to a wide range of soil textures and can tolerate a pH range of 5.2 to 8. Low tolerance to saline soils (USDA NRCS n.d.).
Distribution: Alaska, Yukon, Bank Island, Victoria Island, to Hudson Bay, Newfoundland south to northeastern Oregon, Arizona, New Mexico, northern Texas, western Oklahoma, North Dakota, Manitoba, northern Ontario (Moss 1983).

Phenology

Cool season perennials; flowering is indeterminate; flower from late May to late September; seeds mature in the wild from mid-August to mid-September. In cultivation, seeds begin to mature in late June; plant stands live 5 to 6 years (Pahl and Smreciu 1999).

***Hedysarum boreale* plant in bloom**

***Hedysarum boreale* seed pods (loments)**

Pollination

Insects – mainly bumblebees. Seeds are often empty due to lack of pollinators (Pahl and Smreciu 1999).

Seed Dispersal

Limited scattering when loment dehisce.

Genetics

2n=16 (Moss 1983).

Symbiosis

Associated with nitrogen-fixing rhizobial bacteria (Pahl and Smreciu 1999).

Seed Processing

Collection: In cultivation, expect the first significant seed crops when the plants are three years old. Large crops can be combined or swathed. Small crops should be cut, bagged, hung or spread to dry and threshed (Pahl and Smreciu 1999).
Seed Weight: 4.35 to 5.8 g/1,000 seeds (Royal Botanic Gardens Kew 2008). 70 PLS/g (Hammermeister 1998).
Fruit/Seed by Weight: 260,000 seeds/kg.
Harvest Dates: Late July to early September (Pahl and Smreciu 1999).
Cleaning: Run seed through a coarse screen to remove vegetation bits and other unwanted objects. Sift using a top screen (7 to 7.5/64" round) and a bottom screen (1/15" round) (Pahl and Smreciu 1999).

Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Longevity: 16% germination after 15 years, open storage in a warehouse (Royal Botanic Gardens Kew 2008).
Seed was found to remain viable for 6 years when stored in a dry cool place (USDA NRCS n.d.).

Propagation

Natural Regeneration: Primarily by seed but also spreads rhizomatously (Hardy BBT 1989, USDA NRCS n.d.).
Germination: Pahl and Smreciu (1999) recommended germinating seed in the dark.
Germination occurs 6 to 30 days after planting (USDA NRCS n.d.).
100% germination was achieved when seed was germinated on a 1% agar media in temperatures of 15°C with 8 hours of light and 16 hours dark (Royal Botanic Gardens Kew 2008).

***Hedysarum boreale* seeds**

Pre-treatment: For dormant seed lots scarification may be required. Mechanical scarification of large seed lots is difficult due to varying degrees of seed hardness – many seeds can be broken (Pahl and Smreciu 1999).

Seed were scarified with a scalpel (Royal Botanic Gardens Kew 2008).
Direct Seeding: In cultivation, row cropping is recommended; 60 to 90 cm row spacing; seed in spring or early September at a depth of 0.6 to 0.9 cm (Pahl and Smreciu 1999).
Seed Rate: 80 to 100 seeds/linear m of row.
Vegetative Propagation: No literature found.
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: Important food for many tribes across Canada as well as trappers and settlers. Young roots have a sweet licorice taste and are eaten as a treat. They were boiled, baked, fried, dipped in grease, and added to soups and stews. Spring harvest was best for consumption because roots get woody over the growing season (MacKinnon et al. 2009).
Medicinal: Sun dried roots were burned and smoke was trapped with a blanket over the head as a treatment for sore eyes. A rich source of vitamin C as well as anti-inflammatory, liver protecting, anti-viral and central nervous system stimulating properties (MacKinnon et al. 2009) may also be exploited.
Other: Pieces of root softened at one end by chewing, were used to pacify babies (MacKinnon et al. 2009).

Wildlife/Forage Usage

Wildlife: Fair to good forage for wildlife; used by rocky mountain big horned sheep as well as by mule deer (Pahl and Smreciu 1999). Favorite food of grizzly bears (Tannas 1997).
Livestock: Poor to fair forage for livestock (Pahl and Smreciu 1999).
Excellent food value (USDA NRCS n.d.).
Grazing Response: Increaser (Pahl and Smreciu 1999).

Reclamation Potential

Sweetvetch has been reported to colonize disturbed sites in the mountains and foothills as well as providing niches for other colonizing plants (Pahl and Smreciu 1999). Are important for improving soil nitrogen as well as reducing erosion.

Commercial Resources

Availability: Is available for use in reclamation but recommended to use native seed collected using the Alberta Forest Genetic Management Guidelines.
Cultivars: 'Timp' (USDA NRCS n.d.).
Uses: *Hedysarum* sp. have all been used as ornamental species (Tannas 1997).

Photo Credits

Photos: Wild Rose Consulting, Inc. 2012.

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Scientific Name: *Heracleum sphondylium ssp. montanum* (Schleich. ex Gaudin) Briq.

Family: *Apiaceae*

Common Name: common cow parsnip, cow parsnip

***Heracleum sphondylium* in flower.**

Plant Description

An erect, perennial forb; pubescent or tomentose hollow stems, 1 to 2 m tall, unpleasant smelling; large hairy leaves divided into three segments with lobed and toothed leaflets 10 to 30 cm wide and cordate at the base; numerous flowers with five lobed irregular white petals in a flat-topped umbel 10 to 30 cm across; lance-shaped bracts (Budd and Best 1969, Johnson et al. 1995, Moss 1983).

Fruit: Flat, ovate to hear-shaped schizocarp, 1 cm long, winged, lightly pubescent (Moss 1983) with dark vertical ribs or lines.

Seed: Single brown seed in each segment (Royer and Dickinson 2007).

Habitat and Distribution

Found in moist woods, ditches clearings and other moist areas (Moss 1983) in full sun (USDA NRCS n.d.).

Seral Stage: Early succesional and often after disturbance (Rook 2002).

Soil: Grows in all soil textures, pH between 5.4 and 7.3 with no salinity tolerance (USDA NRCS n.d.) but best on loam and sandy loam textures (Rook 2002).

Distribution: Widespread and common throughout Canada and most of US except the most south-eastern states (USDA NRCS n.d.).

Southern Alaska, Yukon, southwestern District of Mackenzie to Hudson Bay, Newfoundland south to California, Arizona, New Mexico, Kansas, Ohio, Georgia (Moss 1983).

Flowering umbels of *H. sphondylium* showing differential flowering times of inflorescences on the same plant.

Phenology
Umbels on each plant will flower at different times such that seeds will ripen over a long period. In northern Alberta, plants bloom in June and seeds ripen through July.

Pollination
Frequently pollinated by syrphid and tachinid flies (Tooker et al. 2006).

Seed Dispersal
Heracleum sp. are spread by wind as well as by water (Page et al. 2006).

***Heracleum maximum* seeds.**

Genetics
2n=22 (Moss 1983).

Symbiosis
No known symbionts.

Seed Processing
Collection: Hand collected in paper bags (Luna et al. 2008). Has been found to be a skin irritant; it is recommended that gloves are worn if you are handling plants (Tilford 1997).
Seed Weight: 6.0 to 14.6 g/1,000 seed (Royal Botanic Gardens Kew 2008).
Seed by Weight: 105,000 seeds/kg (USDA NRCS n.d.).
Fruit Weight: 217.30 seeds/g or 4.606 g/1,000 seeds.
Harvest Dates: Mid to late August – early September.
Cleaning: Seeds are cleaned using an air blower and screens.
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).
Storage: Viability is lost after five years of storage in a warehouse. Viability maintained when stored in hermetic storage at -18°C (Royal Botanic Gardens Kew 2008).
Longevity: Seed dormancy is non-deep morphological-physiological dormancy (Luna et al. 2008). Seed has remained viable in storage for 8 years (Royal Botanic Gardens Kew 2008).

Propagation
Natural Regeneration: By seed (Rook 2002).
Germination: Germination did not occur in the first year (Luna et al. 2008).
Germination occurred at temperatures 22/17°C (night/day) with pre-treatments (Baskin and Baskin 2001).
96% germination on a medium of 1% agar under temperatures of 5°C in 8 hr light and 16 hr dark (Royal Botanic Gardens Kew 2008).
Pre-treatment: Luna et al. (2008) used the following: pre-planting treatment of a 72 hour water soak of fresh seeds, water changed daily. Seeds were placed into a 100 day cold, moist stratification, i.e., in fine mesh bags and buried in moist peat moss in a ventilated container under refrigeration at 1 to 3°C. The running water pre-soak treatment is necessary to leach out inhibitors on seed coats.
Direct seeding by hand, lightly covered with 50% milled sphagnum peat, perlite, and vermiculite with Osmocote controlled release and Micromax fertilizers. Seeds did not germinate the 1st year; containers were placed in outdoor nursery for remainder of growing season and were winterized outdoors. Initial germination occurred the following spring. Total time to harvest was 1.5 years.

112 day cold stratification was used to coax seed to germinate (Baskin and Baskin 2001).
Vegetative Propagation: No literature found.

Aboriginal/Food Uses

Food: Young stalks can be roasted and the pith scraped out and eaten; stem marrow has a sweet licorice taste and can be eaten raw or cooked as can leaf stalks; roots can also be cooked (Johnson et al. 1995, Turner 1997). *H. maximum* can be substituted for celery and eaten raw or cooked (MacKinnon et al. 2009).
Medicinal: A paste can be made with *H. maximum* roots and applied to relive swollen or aching limbs (Johnson et al. 1995). Cooked roots can be ingested to treat gas, colic and cramps, and fresh roots are used as a tea to relieve sore throats, coughs and headaches (MacKinnon et al. 2009). However, caution is necessary: this plant contains furanocoumarins (light-activated antimicrobials) so the roots and outer skin of the plant can irritate and blister skin and lips and may damage DNA (Johnson et al. 1995, MacKinnon et al. 2009).
Can also be used as an immunostimulant as well as has significant anti-fungal, antimycobacterial and antiviral properties (Webster et al. 2006).
Other: Stalks were part of Sun Dance rituals of the Blackfoot Tribe (Tannas 2004).

Wildlife/Forage Uses

Wildlife: It is moderately palatable to grazing and browsing animals as well as to humans (USDA NRCS n.d.) and decreases with grazing. In the fall, deer, elk and bears eat the stems and leaves, and birds eat the seeds (Johnson et al. 1995).
Livestock: Forage value is good, palatable all season long (Tannas 2004).
Grazing Response: A decreaser and in some cases an increaser depending on livestock accessibility to area; plants produce numerous seeds large food reserves in its roots so it can withstand some grazing (Tannas 2004).

Reclamation Potential

Said to be moderately good for soil stabilization and erosion control (Parks Conservancy 2013).

Commercial Resources

Availability: None known in Alberta.

Notes

Heracleum maximum is listed as 68% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Can be confused with *Heracleum mantegazzianum* which is an invasive weed in Canada *(*Page et al. 2006).
Synonyms include *Heracleum maximum* and *Heracleum lanatum* (ITIS n.d.).
Known in British Columbia as Indian rhubarb or wild rhubarb (Turner 1997).
The genus refers to the son of Zeus, Hercules.
Has been known to cause dermatitis in humans (Budd and Best 1969).

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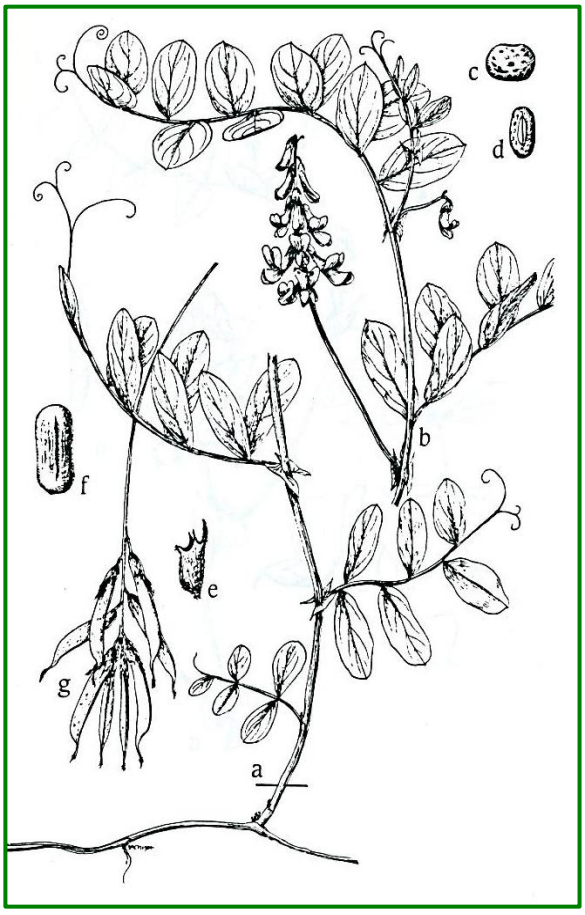
Scientific Name: *Lathyrus ochroleucus* Hook **Family:** *Fabaceae*

Common Names: cream pea, creamy peavine, pale vetchling peavine



***Lathyrus ochroleucus* Illustration**
a. habit (inflorescence and leaves)
b. flower c-d. seeds e calyx f. pollen
g. seeds pods

Plant Description

Stems up to 1 m tall, climbing on surrounding vegetation for support; leaves alternate, pinnately compound with 6 to 10 leaflets; leaflets oval, 2.5 to 5 cm long, hairless; tendrils branched; stipule oval to somewhat heart-shaped; raceme flower cluster, 5 to 10 flowers borne on leaf axis; flowers are yellowish-white, irregular, 12 mm long, sepals 5, petals 5 (Royer and Dickinson 2007).

Fruit: Legume 2 to 4 cm long, hairless; seeds 4 to 6.
Seed: Globular seed, 2.5 to 4 mm in size (Burton and Burton 2003).

Habitat and Distribution

Moist woods and clearings (Moss 1983).
Soil: Prefers loam to sandy loam textured soils that are relatively neutral in pH (Burton and Burton 2000).
Distribution: Southeast Alaska, British Columbia, western District of Mackenzie to Quebec south to Washington, Wyoming, South Dakota, northwestern Nebraska, Ohio, Pennsylvania, Vermont (Moss 1983).

Phenology

Flowers bloom from June to July (Royer and Dickinson 2007); early to mid-June in Alberta (Beaubien and Johnson 1994). Ripe seeds appear in late summer.

Pollination

Insect pollinated by bees and butterflies (Hilty 2011).

Genetics

2n=14 (Moss 1983).

Symbiosis

Members of the Fabaceae family are associated with rhizobia bacteria.

Seed Processing

Collection: Cut pods off the plant, as they turn brown with a sharp pair of clippers or scissors and place in paper bags (Burton and Burton 2003). Large crops can be harvested with a thrasher or combine at settings of 885 rpm with a 4 mm gap (Burton and Burton 2000).
Seed Weight: 16.4 g/1,000 seed (Royal Botanic Gardens Kew 2008).

Fruit/Seed by Weight: 61 seeds/g or 16.4 g/1,000 seeds (Burton and Burton 2003).
Harvest Dates: End of July to early September.
Cleaning: Put through vacuum separator with speed set high although suction many lose some smaller seeds. Alternatively fanning mill separation can be used if needed (Burton and Burton 2003).
Storage Behaviour: Orthodox, seeds can be dried, without damage, to low moisture contents. Longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Cool dry storage (Burton and Burton 2003).
Longevity: Reported to remain in seed bank for many years before germinating (Tannas 1997).

Propagation

Germination: Germinate better in cooler conditions. At 25/15°C, it takes 18 days for seeds to begin germinating (Burton and Burton 2003).
Pre-treatment: Stratification or scarification scoring or cracking the seed coat is beneficial for most legume species.
Direct Seeding: Sow in fall to allow winter stratification to assist in breaking seed dormancy (Burton and Burton 2003).
Seed Rate: Optimal seeding rate not known, but Smith and Smith (2000) suggest 60 to 100 pure live seed per linear metre.

Aboriginal/Food Uses

Food: *L. ochroleucus* contains neurotoxins that, if eaten in moderation, are a nutritious food; but if eaten exclusively for more than 10 days can be poisonous (Mackinnon et al. 2009).

Wildlife/Forage Usage

Wildlife/Livestock: Good forage for both wildlife and livestock high in protein and nutrients (Tannas 1997).
Grazing Response: Decreaser (Tannas 1997).

Reclamation Potential

Peavine is found to grow naturally in disturbed areas though is not good competitor. It can tolerate saline soils but pH must be close to neutral (Burton and Burton 2003).

***Lathyrus ochroleucus* flower**

Notes

L. ochroleucus is listed as 83% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Jason Hollinger @ Wiki commons 2009.

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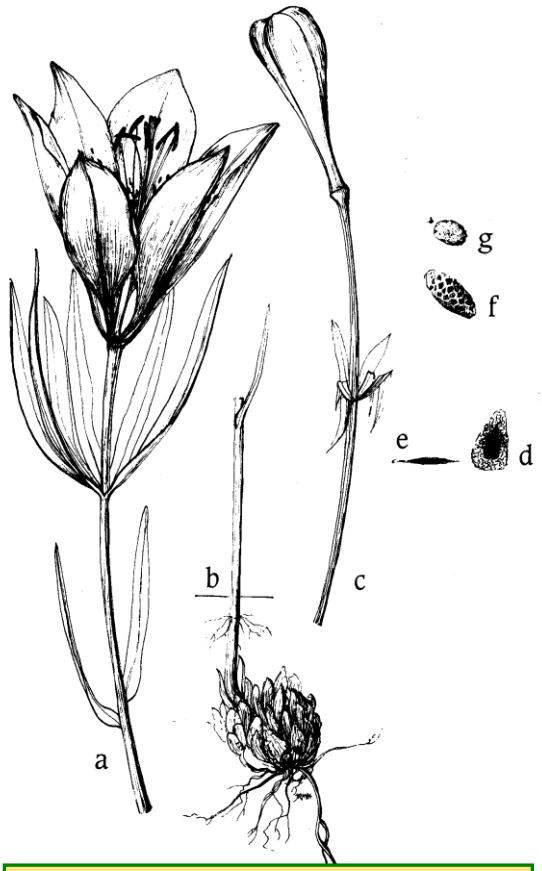
Scientific Name: *Lilium philadelphicum* L. **Family:** *Liliaceae*

Common Names: tiger lily, wood lily, prairie lily, wild lily, red lily, western red lily



***Lilium philadelphicum* a. flowering stem b. below ground corm and roots c. seed capsule d&e. seed f&g. pollen**

Plant Description

Erect, smooth, leafy perennial, 30 to 60 cm high; leaves 5 to 10 cm, linear to lance-shaped, alternate, whorled at flower; single or triple bloom per stem; orange to red, dotted black/purple petals and sepals, 5 to 8 cm long, dark purple anthers; white, thick-scaled bulb (Moss 1983).

Fruit: Cylindrical to egg-shaped capsule, 2 to 4 cm (Moss 1983).

Seed: Flat, triangle to tear shaped seed, golden yellow with darker centre, 4 to 7 mm, raised welts on surface (Moss 1983).

Habitat and Distribution

Lilies are most often found in clearings in woodlands, prairies, roadside, and meadows. Lilies take advantage of margins, such as those resulting from forestry cut lines and road building. Somewhat shade intolerant (Johnson et al. 1995).

Seral Stage: Late seral, although establishing in margins, lily is one of the later species to invade.

Soils: Sandy to loamy, well-drained soils, more tolerant of higher pH than lower (Johnson et al. 1995).

Distribution: Scattered in the Rocky Mountains, boreal forest and parkland in Alberta. Southeastern British Columbia to western Quebec south to New Mexico, North Dakota, Michigan, Ohio (Moss 1983).

Phenology

Blooms June to July (ALCLA Native Plants n.d.). Stems and seeds ripen in August and September (Moss 1983).

Pollination

Swallowtail and monarch butterflies, as well as sweat bees have been observed as pollinators (Lawrence and Leighton 1999). It is also pollinated by wind (Cook 1988).

Seed Dispersal

Likely wind dispersed (Horning and Webster 2009).

Genetics

2n=24 (Moss 1983)

Symbiosis

Vesicular-arbuscular mycorrhiza (Currah and Van Dyk 1986).

***Lilium philadelphicum* is an herbaceous perennial of the boreal forest.**

Seed Processing

Collection: Ripe stems detach easily from bulb. Once the flower is gone the plant is difficult to spot in the field it is suggested that collection sites be scouted out and marked while it is still in bloom.
Seed Weight: 0.83 g /1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: Late July-early August.
Cleaning: Air-dry fruits at ambient temperature. If capsules are intact, open capsules and empty seeds. Otherwise crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing.
Storage Behaviour: Orthodox, seeds can be dried, without damage, to low moisture contents. Longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Seed should be stored dry. 94 % viability following drying to a moisture content of 15% and freezing for 5 months at -20ºC (Royal Botanical Gardens Kew 2008).
Longevity: Seed viable for at least 2 years.

Propagation

Germination: 90% germination in 30 days, fresh, 1 or 2 year old seed in north-eastern Alberta.
Royal Botanic Gardens Kew (2008) achieved 94% to 100% germinations on a 1% agar media.
Pre-treatment: 30 to 60 days cold stratification (2 to 4°C) (Prairie Moon Nursery Inc. 2011).
No pre-treatment required (Smreciu et al. 2012).
Direct Seeding: Seeds sown directly into reclaimed soils in northeastern Alberta emerged well and matured to become reproductive in a pre-trial plot but have not emerged in other trails (Smreciu et al. 2012).
Seeding Rate: 200 seeds/m² to obtain 2 plants/m².
Vegetative Propagation: Using undamaged scales of underground bulb. Dispersed by mice and small rodents when they dig the bulbs for food.

Aboriginal/Food Uses

Food: Tubers can be eaten fresh or dried (Royer and Dickinson 1996).
Flowers, seeds and bulbs can be eaten raw; bulbs are best boiled in two changes of water. Bulbs can be dried whole or mashed and dried (Northern Bushcraft n.d.).
Medicinal: Crushed leaves used to make a poultice to treat small poisonous spider bite root as part of a compound medicine can treat heart problems; boiled tubers eaten as a soup can treat appendicitis; and a dried tuber placed in a tooth cavity then crushed can relieve toothaches (Royer and Dickinson 1996).

Wildlife/Forage Usage

Wildlife: Bulb scales may be eaten by rodents and other small mammals. Grizzly bears also feed on lily bulbs. Utilized by a variety of other wildlife species although of little forage value.
Livestock: Fair forages value (Gerling et al. 1996).
Grazing Response: Not able to withstand heavy grazing.

***Lilium philadelphicum* seeds**

Reclamation Potential

May establish on margins of wooded areas.
Wild Rose Consulting did not see any emergence of seedlings after two growing seasons on oil sands reclamation sites (Smreciu et al. 2012).

Commercial Resources

Availability: Not widely available but some producers exist in Alberta.

Cultivars: None are known.
Uses: Horticultural.

Notes

Tiger lily is listed as 94% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Is a prolific seed producer.
Genetic diversity is maintained by fire, which releases dormant bulbs, lowers competition with other plants and removes cover for small mammals therefore reducing the rate of grazing and the rate of seedling establishment (Lawrence and Leighton 1999).

Photo Credits

Photo 1: Glen Lee, Regina Saskatchewan
Photo 2: Wild Rose Consulting, Inc. 2012.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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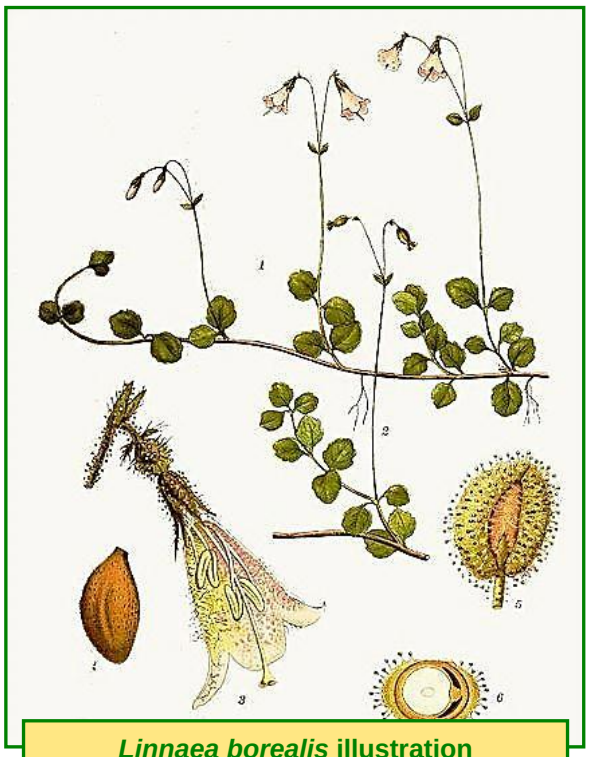
Scientific Name: *Linnaea borealis* L. ssp. americanum (Forbes) Hult.
Family: *Caprifoliaceae*

Common Names: northern twinflower



***Linnaea borealis* illustration**

Plant Description

Creeping woodland plant, stems slender, semi-woody, often 1 m long, forming loose mats, 3 to 10 cm tall; leaves opposite, evergreen, oblong to oval, 8 to 20 mm long, 3 to 15 mm wide; short stalked; margin with 2 pairs of notches near the leaf tip; flower cluster, 2 flowers borne on top of a Y-shaped stem; flowers pinkish-white, funnel-shaped, pendent, 8 to 15 mm, fragrant (Moss 1983, Royer and Dickinson 2007).

Fruit: Capsule 4 to 5 mm long; single seeded (Royer and Dickinson 2007).

Seed: One seed per fruit (Barrett and Helenurm 1987).

Habitat and Distribution

Common understory species in boreal and mixedwood forests in Alberta (Tannas 1997).

Seral Stage: Facultative seral species; *Linnaea borealis* has been found in disturbed areas such as cut blocks as well as climax communities (Howard 1993).

Soil: Soil parent material, textures and nutrient levels vary. Soil moisture ranges from hydric to xeric and soil pH can range from 4 to 7 (Howard 1993).

Distribution: Circumpolar. Alaska, Yukon, District of Mackenzie to Hudson Bay, northern Quebec, Newfoundland south to California, Arizona, New Mexico, South Dakota, Indiana, West Virginia (Moss 1983).

Phenology

L. borealis blooms from June to July through most of its range; the flowers last for 7 days (Howard 1993). Seeds mature in 36 days (Rook 2002).

Pollination

Pollinated by insects as well as self-fertile in rare occasions (Howard 1993).

Seed Dispersal

Barbed seed catches on fur of animals (CYSIP: Botany n.d., Royal Botanic Gardens Kew 2008).

Genetics

2n=32 (Moss 1983).

Symbiosis

Form arbuscular mycorrhizal associations (Kranabetter and MacKenzie 2010).

Seed Processing

Collection: Allow seed pods to dry on plant, break off and put in paper bags (Dave's Garden 2011).

Seeds stick to cloth due to a barbed outer coating. This makes them easy to collect but difficult to clean.
Seed Weight: 2 g/1,000 seeds Royal Botanic Gardens Kew 2008).
Harvest Dates: August (Luna et al. 2008).
Cleaning: Seeds are hand cleaned by rubbing capsules against screens (Luna et al. 2008).
Storage Behaviour: Most likely orthodox; dry seed to low relative humidity and store cold but this is unproven (Royal Botanic Gardens Kew 2008).
Storage: Store cool and dry (Luna et al. 2008).
Longevity: Unknown but does not remain viable in soil seed banks for long periods of time (Howard 1993); shown to form a short-term persistent soil seed bank, with seeds surviving in the soil for 1 to 5 years (Royal Botanic Gardens Kew 2008).

***Linnaea borealis* in flower**

Propagation

Natural Regeneration: Vegetative reproduction by stolons is the primary method of reproduction despite prolific seed production (Howard 1993).
Germination: Germination occurred following several days at 22°C or higher. Germination continued for over 1 month (Luna et al. 2008).
Pre-treatment: 5 month outdoor stratification with a minimum of a 60 day cold, moist stratification is recommended (Luna et al. 2008).
Direct Seeding: Sow seed in the fall (Dave's Garden 2011).
Vegetative Propagation: Root balls may be divided as well as propagation from stem cuttings (Dave's Garden 2011).

Aboriginal/Food Uses

Food: It was reported that Carrier Indians used them as food (Montana Plant Life n.d.).
Medicinal: Was used as a tonic in pregnancy, treatment of painful menstruation, cramps, fever or for crying. A decoction of leaves was taken for coughs and colds. The mashed plant was used as a poultice on inflamed limbs and applied to the head to treat headaches (Gray 2011, Montana Plant Life n.d.).
Other: Can be used as a horticultural plant (Montana Plant Life n.d.).

Wildlife/Forage Usage

Wildlife: Used by ruffed grouse and as winter forage for elk (Howard 1993).
Livestock: Poor forage but will be used if better alternatives are not present (Tannas 1997).
Grazing Response: Increaser, but not aggressive (Tannas 1997).

Reclamation Potential

Can tolerate acidic soils. Is an important species in providing ground cover in forests (Tannas 1997).

Commercial Resources

Availability: Not currently grown commercially in Alberta (ANPC 2010).
Seeds have been collected by the Oil Sands Vegetation Cooperative for use in the Athabasca oil sands region.
Use: Used to treat shingles, rashes and rheumatism in Norway (Alm 2006).

Notes

L. borealis is listed as 86% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Kohn and Lusby (2004) found that transplanting this species was not successful; 90% of the transplants died.

The flower's incredibly sweet scent is strongest near evening (CYSIP: Botany n.d.).

Photo Credits

Photo: Ghislain118, wikimedia commons 2009.
Line Diagram: Illustration by Carl Axel Magnus Lindman (1928), scanned from the book "Bilder ur Nordens Flora".

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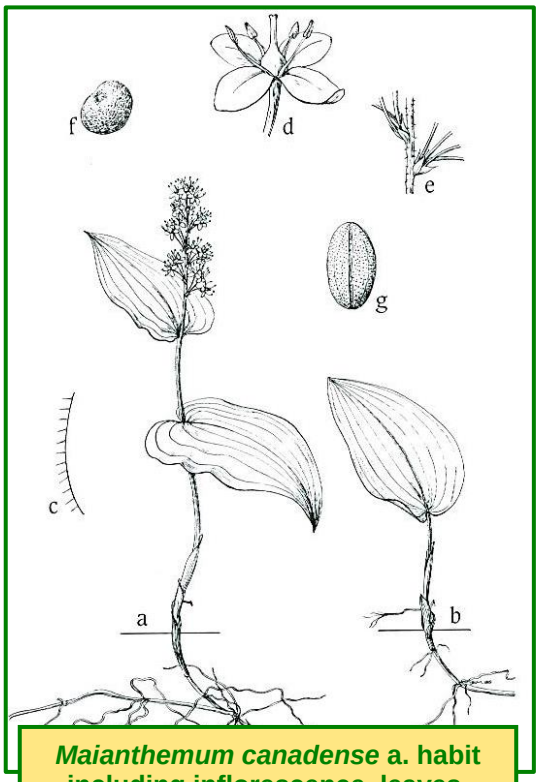
Scientific Name: *Maianthemum canadense* Desf.
Family: *Asparagaceae*

Common Names: wild lily-of-the-valley, false lily-of-the-valley, Canada mayflower



Maianthemum canadense **a. habit including inflorescence, leaves, rhizomes and roots b. vegetative habit c. leaf margin d. flower e. branching inflorescence f. seed g. pollen**

Plant Description

Low perennial herb with creeping slender branching rhizomes; erect flowering stems, each with 1 to 3 sessile or short stocked leaves and an accompanying long-stalked basal leaf; stems 5 to 20 cm tall; leaf blades 2 to 8 cm long, ovate to oblong-lanceolate, cordate at base, more or less pubescent; flowers small, 4 to 6 mm wide, white, in a short terminal raceme (MacKinnon et al. 2009, Moss 1983).

Fruit: A pale red berry, globose, 3 to 4 mm thick, 1 to 2 seeded (Moss 1983).

Seed: Ovoid, somewhat translucent, often tinged pink by fruit. Approximately 5 mm in diameter (MacKinnon et al. 2009).

Habitat and Distribution

Moss or leaf litter layer in moist aspen and spruce forests on ridge tops, steep to gentle slopes, rolling hills and low lands (Pavek 1993).

Seral Stage: Facultive seral species most often later stages of succession (Pavek 1993).

Soil: pH ranges between 4.5 and 5.5 and is found mainly on moderately drained soils but is occasionally found on well-drained and saturated soils (Pavek 1993).

Distribution: Common. Western District of Mackenzie, eastern British Columbia to Labrador and Newfoundland south to central Saskatchewan, North Dakota, Great Lakes, Appalachia (Moss 1983).

Phenology

Flowers from end of May to early July. The fruit matures within a month after the flower has finished. Can live 30 to 60 years (Pavek 1993).

Fruit is hard and white or greenish, becoming red and juicy after first frost.

Pollination

Is self-incompatible, insect pollinated by solitary bees, bee flies, and syrphids (Spencer et al. 1987).

Seed Dispersal

Showy fruit is most likely indicative of animal dispersal.

Genetics

2n=36, 54, 72 (Moss 1983).

Maianthemum canadense in flower

Seed Processing

Collection: Collect by hand in late summer - once fruit turns red. To prevent damage to fruit, cut stalk.
Seed Weight: 9.05 g/1000 seeds.
Fruit/Seed Volume: 10,880 seeds/L.
Fruit/Seed Weight: 19,070 seeds/kg.
Average Seed/Fruit: 1.3.
Harvest Dates: Mid to late September.
Cleaning: Macerate fruit in blender; decant water and pulp to isolate fruit. Allow to dry open to the air.
Storage Behavior: Likely Orthodox; seeds can be dried, without damage, to low moisture contents their longevity increases with reductions in both moisture content and temperature.
Storage: Viability drops after a full year of cool dry storage. *M. canadense* seeds maintained a 60% viability when dried to a 15% moisture content and stored at -20°C for 1 month (Royal Botanic Gardens Kew 2008).
Longevity: Unknown.

Propagation

Natural Regeneration: Reproduces vegetatively through rhizomes as well as by seed (Pavek 1993).
Germination: Up to 50% germination of fresh seed following 12 weeks cold stratification. Up to 10% of year old seed.
Pre-treatment: Seeds are placed in cold moist stratification for 71 to 112 days before planted (Baskin and Baskin 2002).
12 weeks cold stratification.
Direct Seeding: Collect fruits in the summer when berries are ripe and red. Remove the pulp from the seed then plant immediately outdoors (Lady Bird Johnson Wildflower Center 2009). May take 2 years to germinate (Diboll 2008).
Vegetative Propagation: Divide rhizomes in the fall after the leaves have turned yellow, place immediately in soil 1.5 cm underground and mulch (Lady Bird Johnson Wildflower Center 2009).

Aboriginal/Food Uses

Food: Berries are edible eaten fresh picked or mixed with other fruits to make sun dried fruit cakes (MacKinnon et al. 2009). Berries should not be eaten in large quantities as they can cause indigestion and may actually be poisonous (Royer and Dickinson 1996).

Maianthemum canadense seed

Medicinal: Used to treat sore throats and headaches. A leaf poultice was made for swellings in the limbs or burned to make inhaling smoke (MacKinnon et al. 2009).

***Maianthemum canadense* growing on forest floor**

Wildlife/Forage Usage

Wildlife: Important spring and summer food for white tail deer (Skinner and Telfer 1974). Berries are also eaten by frogs (MacKinnon et al. 2009).
Grazing Response: Can tolerate a moderate amount of grazing. *M. canadense* reproduce and grow from rhizomes and retain their connections underground. Though each genet grows independently once mature, it produces daughter plants and when the colony is damaged it can transfer nutrients (photoassimilate) to support the damaged plant (Rooney 1997).

Reclamation Potential

Rhizomatous nature indicates this species might be beneficial for erosion control.

Availability: Is available in Alberta nurseries (ANPC 2010).
Cultivars: No literature found.
Uses: Landscaping/gardening.

Notes

Maianthemum canadense is listed as 84% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

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Scientific Name: *Melampyrum lineare* Desr. ***Family*:** Orobanchaceae

Common Names: cow-wheat, narrowleaf cow-wheat

M. lineare in bloom

Plant Description

Annual, reaching 1 to 4 dm high, usually with a few slender branches; stem downy or nearly glabrous; leaves 2 to 5 cm long, opposite, lanceolate or linear-lanceolate, mostly entire, the uppermost often aristate-toothed near the base, usually somewhat glandular-hairy; flowers solitary in the leaf axils or in the terminal leafy spikes; bracts usually with a few divergent teeth near the base; calyx 4-lobed, somewhat glandular-hairy; corolla 8 to 12 mm long, tubular, whitish to purplish and yellow-tipped, 2-lipped: upper hooded and mostly entire, lower 3-lobed; 4 stamens (Moss 1983, Tannas 2004).
Fruit: A flat, oblong, beaked capsule; partially enclosed in the calyx; 6 to 10 mm long; contains 1 to 4 seeds (Vance et al. 1984).
Seed: 2 to 4 mm long, blackish with light coloured tips when mature (Moss 1983).

Habitat and Distribution

Commonly found in the Boreal forest, occasionally in the foothills and montane regions; grows in moist, boggy wooded areas, mossy coniferous forests and often in drier, sandy, jack pine forests (Tannas 2004). Gibson (1993) describes *M. lineare* as occurring mostly in acidic, nutrient poor, fire-prone habitats.

Species of the genus *Melampyrum* have been linked to moss and reindeer lichen microsites, and the seedling niche for *M. lineare* has been characterized as prevalently high in moss and lichen cover, high in light intensity, and relatively far from shrubs (instead with herbs as the nearest neighbour); light intensity is the most important physical habitat factor that effects *M. lineare* survival and growth (Gibson 1993).
Seral Stage: Early successional (Tannas 2004).
Soil: Sandy, well-drained (Vance et al 1984).
Distribution: British Columbia to Newfoundland south to Washington, Idaho, Montana, Minnesota, Wisconsin, Indiana, Tennessee, Georgia, South Carolina (Moss 1983).

Phenology

In northern Michigan, blooming occurs from early July through September and fruiting from late July to mid-October (Gibson 1993).

Pollination

Plants are pollinated by insects and are capable of self-pollination (Cantlon et al. 1963).

Seed Dispersal

Seed is carried away from plant intentionally by ants due to its elaisome (a fleshy structures attached to seed that is rich in proteins and lipids) (Royal Botanic Gardens Kew 2008).

Genetics

2n=18, 36 (Moss 1983).

Symbiosis

Mutualism with ants for seed dispersal purposes; plant itself is a hemi-parasite (Gibson 1993).

Seed Processing

Collection: Collect whole plants (Curtis and Cantlon 1968).

Seed Weight: 2.414 g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: August to September (Malcolm 1964).
Cleaning: Allow plants to air dry for 24 hours. This will cause the ripe capsules to split open and release the seeds (Curtis and Cantlon 1968). Carefully remove and discard the plants, the released seeds should be left behind on the collecting surface (Malcolm 1964).
Storage Behaviour: No literature found.
Storage: Store in a plastic bag with moist litter from the seed collection area, or on a moist blotter (Cantlon et al. 1963). The seeds will become unviable if allowed to dry out (Gibson 1993).
Longevity: Two years if kept moist (Cantlon et al. 1963).

Propagation
Natural Regeneration: From seed. Some of the seed crop will produce roots from resources contained in the seeds during the first autumn, with green shoots emerging the following spring; other seeds can remain dormant for up to five years. Seeds will do best in a moist microenvironment, and also have a higher germination rate when ant-planted (Gibson 1993).
Germination: Germination can vary widely, between 2% and 100% (Cantlon et al. 1963). Baskin and Baskin (2001) list the optimum germination temperature for *M. lineare* as 3°C. Desiccated seeds will not germinate (Gibson 1993).
Germination will begin after 60 to 80 days in cold storage, and can continue for up to 120 days; germination will cease if the seeds are removed to room temperature (Cantlon et al. 1963).
Pre-treatment: Seeds display intermediate physiological dormancy which can be broken by 60 to 80 days of cold stratification; preceding cold stratification with 1 month of moist storage at 20°C increases germination to about 30% (Baskin and Baskin 2001, Cantlon et al. 1963). Treatment with gibberellic acid (GA) can substitute for the 1 month of warm stratification, and can increase the germination percentage to up to 100% (Baskin and Baskin 2001, Cantlon et al. 1963). For this method, Malcolm (1964) suggests soaking freshly harvested seeds in a 1,000 ppm GA solution for 24 hours, and then using the same solution to keep the seeds moist during the cold stratification period. Seedling survival requires an extra 20 to 30 days cold storage after emergence of the radicle (Cantlon et al. 1963).
Direct Seeding: Plants can be grown from seed in a greenhouse or a field setting (Cantlon et al. 1963; Gibson 1993).
Gibson (1993) hand-planted *M. lineare* seeds in Michigan by lifting clumps of ground cover (mosses, lichens, or leaf litter), and depositing seeds directly onto the soil surface underneath. He found that seeds deposited under lichens had the highest success rate; however his hand-planted seeds under all cover types had lower germination rates and plant survival than naturally ant-planted seeds.
Planting Density: Cantlon et al. (1963) seeded 5-inch diameter clay pots in a greenhouse with three seeds per pot.
Seed Rate: No literature found.
Vegetative Propagation: No literature found.
Micro-propagation: No literature found.

Aboriginal/Food Uses
Food: No literature found.
Medicinal: An infusion from the plant was used by the Ojibwa as an eye medicine (Smith 1932).
Other: No literature found.

Wildlife/Forage Usage
Wildlife: No literature found.
Livestock: Poor forage value; does not produce enough foliage for forage (Tannas 2004).
Grazing Response: Increaser in adapted range (Tannas 2004).

Reclamation Potential
Although *M. lineare* is characterized as non-aggressive, it is capable of providing immediate cover on disturbances; for this reason it is considered of some value in the early successional phases of site restoration (Tannas 2004). It is capable of maturing without host plants, however will be stunted and more susceptible to drought and disease (Malcolm

1964). Jack pine is a possible host for *M. lineare* (Malcolm 1964).

Commercial Resources

Availability: Not commercially available.
Cultivars: No literature found.
Uses: No literature found.

Photo Credits

Photo 1: Jomegat 2013 @ Wikimedia Commons.

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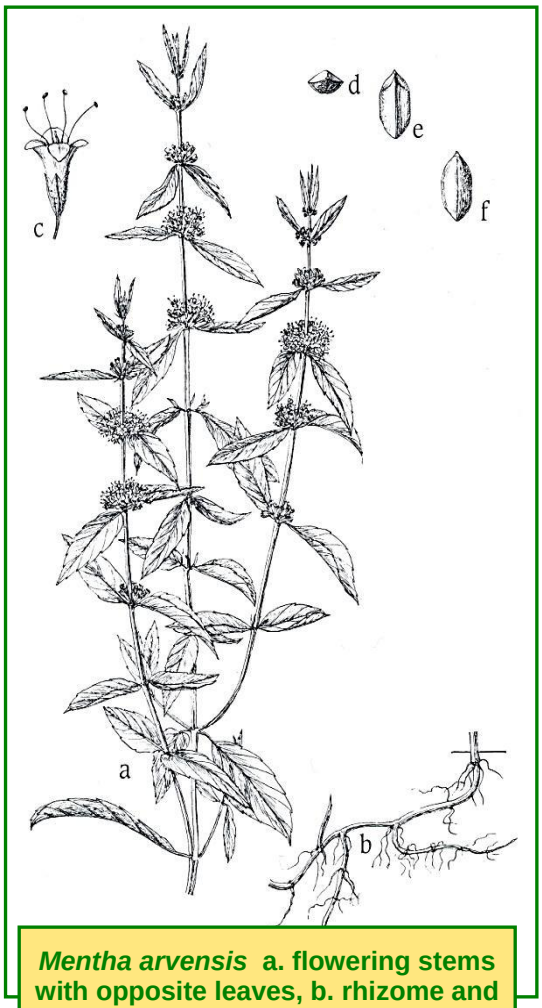
Scientific Name: *Mentha arvensis* L. **Family:** *Lamiaceae*

Common Names: wild mint, field mint



Mentha arvensis **a. flowering stems with opposite leaves, b. rhizome and roots, c. individual flower, d to f. seeds.**

Plant Description

Aromatic, erect perennial herb, with pubescent square stems, 15 to 50 cm high; leaves short-petioled, opposite oblong-lanceolate to ovate lanceolate, 1 to 8 cm long, serrate, rounded at base; pink to pale purple or white small flowers in dense axillary clusters, corolla 4 to 6 mm long fused into 4 to 5-lobed tube (Moss 1983).

Fruit/Seed: Four small, ovate nutlets at base of calyx, brown, ovoid, triangular at base, basal crescent-shaped depression (Moss 1983).

Habitat and Distribution

Common in sloughs and wet places, stream banks, lakeshores, wet meadows, clearings, marshy grounds, and throughout the prairies (USDA NRCS n.d.).

Soil: Tolerates periods of flooding (Gerling et al. 1996).

Is adapted to medium and fine textured soils and can tolerate a pH ranging from 5 to 7 (USDA NRCS n.d.).

Mentha arvensis **showing axillary clusters of flowers.**

Distribution: Widespread across Alberta and much of North America and Eurasia. Circumboreal and circumpolar. Alaska, Yukon, southwestern District of Mackenzie to James Bay, Newfoundland south to California, New Mexico, Texas, Missouri, West Virginia, Delaware (Moss 1983).

Phenology

Flowers in June to July (Currah et al. 1983).

Pollination

Insect.

Seed Dispersal

Wind and water dispersed.

Genetics

2n=12, 24, 48, 64, 72, 90, 92, 96, 120, 132.

Symbiosis

Inoculation of vesicular–arbuscular mycorrhizal (VAM) fungus *Glomus fasciculatum* significantly increase the productivity of wild mint (Gupta et al. 2002).

Seed Processing

Collection: Hand-picking of fruiting stems.
Seed Weight: 0.099 to 0.106 g/1,000 seeds
Harvest Dates: June and late August.
Cleaning: Air-dry fruiting stems in paper or Tyvek bags at 15 to 25°C. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing.
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents; their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: Royal Botanic Gardens Kew (2008) recommends IPGRI preferred conditions; these involve drying seed to low moisture content (3% to 7% fresh weight, depending on the species) and storing them, in hermetically-sealed containers, at low temperature, preferably at -18ºC or cooler (Fassil and Engels 1997).
Longevity: Up to 6 years.

Divisions or cuttings showing shoot and rhizome with some roots.

Propagation

Natural Regeneration: Rhizomes regenerate shoots from their nodes (Bahl et al. 2002).
Germination: 78% to 100% germination on 1% agar media with varying pre-treatments and temperatures; the highest germination was achieved by germinating seed at 21°C with 12 hours light and 12 hours of dark, and pre-treatments (Royal Botanic Gardens Kew 2008).
Pre-treatment: Germination increases if cold stratified for at least 4 weeks. Thompson et al. (1977) suggest that a 4.5°C fluctuating temperature is required to promote germination under light. Royal Botanic Gardens Kew (2008) acquired their highest germination when they sterilised the seed (immersed

in 10% Domestos solution for 5 min), then scarified it (chipped with scalpel) and added 250 mg/l gibberellic acid (GA3) to agar.

Vegetative Propagation: Regenerates primarily by rhizomes. 90% of rhizomes survived the first year and fully established by year three. *Mentha arvensis* spreads in wetlands.

Propagates by rhizome cuttings or division of plants in spring or fall; by tip cuttings in spring, if cuttings placed in sand or vermiculite under intermittent mist or in heated frames, they will root in 21 to 28 days (Currah et al. 1983)

Cold stored suckers can serve as direct sowing material for the late summer crop of mint (Bahl et al. 2002).

Micro-propagation: Have been micro-propagated from axillary buds (Rech and Pires 1986).

Aboriginal/Food Uses

Food: Mint tea is made by boiling the leaves.

Medicinal: Tea can be taken to treat a cough, a cold, congestion, fever, chills, menstrual cramps, to soothe teething babies' gums, to treat tiredness or fatigue, to aid with digestion, to treat children's diarrhoea, to treat headaches and to treat high blood pressure. Also, part of a compound medicine to treat cancer or diabetes, or pain, and used as a wash for sores. Flowers can be grinded and mixed with yarrow and water to use as a wash for infected gums or to relieve a toothache.

Commercial Resources

Availability: Available through a few nurseries in Alberta and Manitoba.

Cultivars: Available cultivars are not suitable for reclamation.

Uses: Industrial crop used for the production of menthol for use in cosmetic, pharmaceutical, food, and flavouring industries (Gupta et al. 2002).

Photo Credits

Photos: Wild Rose Consulting, Inc.

Line Diagram: John Maywood, of Bruce Peel Special Collections used by permission University of Alberta.

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Scientific Name: *Mertensia paniculata* (Ait.) G. Don. **Family:** *Boraginaceae*

Common Names: bluebell, tall lungwort, tall bluebell

***Mertensia paniculata* panicle in bloom**

Plant Description

Perennial herb. Stems are mostly 20 to 80 cm tall, hirsute or villose, erect from woody caudex; basal leaves long petioled, cordate-ovate to elliptic-lanceolate, pubescent on both sides; cauline leave short-petioled, alternate and sessile, lanceolate, often acuminate and hirsute; inflorescence congested growing to paniculate; calyx strigose; corolla 0.8 to 1.4 cm long, with conspicuous scales on the throat (Moss 1983).

Seed: Each flower can produce up to 4 nutlets, 2.5 to 5 mm long (Borealforest.org n.d., Reeves 2006).

Habitat and Distribution

Found in moist, often shaded places, rich lush woodlands, willow thickets, moist depressions/meadows and stream banks (Tannas 1997).

Seral Stage: Shade tolerant species found in early to late seral stage. More common mid-seral, although it is found post-fire in early succession as well (Reeves 2006).

Soil: Moderately moist, relatively nutrient rich soils (Beckingham and Archibald 1996).

Distribution: Throughout Alberta. Alaska, Yukon, southwestern District of Mackenzie to southern Hudson Bay south to Oregon, Montana, Alberta, Saskatchewan, Manitoba, Minnesota, Iowa, Michigan (Moss 1983).

Phenology

Flowers in June and July (ALCLA Native Plants n.d., Plants for a Future n.d.).

Pollination

Insect pollinated, by bumblebees (Reeves 2006).

Seed Dispersal

Wind dispersed after capsules dry and break.

Genetics

2n=24, 72 (Moss 1983).

Symbiosis

Forms vesicular arbuscular mycorrhizal associations (Currah and Van Dyk 1986).

Seed Processing

Collection: Collect by hand, clipping heads to prevent shatter and seed loss. Once plants lose their leaves seed heads are very inconspicuous.

Harvest Dates: Late August/September.

Cleaning: Put the seed in a bag and crush it followed by winnowing or screening.

Storage Behaviour: Likely orthodox; dry seed to low relative humidity and store at freezing temperatures.

Storage: No literature found.

Longevity: No literature found.

Propagation

Natural Regeneration: Naturally regenerates from thick rhizomes.

Germination: Poor (<10%) (Treberg and Turkington 2006).

Pre-treatment: Soaking may improve germination, as does removal of seed coat. However, the improvement is not probably sufficient for the time required to tease the seed away from the coat without damaging the embryo (Treberg and Turkington 2006).

Vegetative Propagation: May be divided, with care, in early spring or autumn (Plants for a Future n.d.).

Aboriginal/Food Uses

Food: Dried leaves and flowers can be made into tea, fresh leaves can be added to soups or casseroles (Borealforest.org n.d., Gray 2011, Royer and Dickinson 2007), but is a bit too hairy for salads (Borealforest.org n.d.).

Medicinal: Used as part of a compound medicine for treatment of heart trouble (Marles et al. 2000).
The dried leaves were used in herbal tea mixtures, especially when treating the lungs (Borealforest.org n.d). effective at relieving diarrhea and hemorrhoids (Gray 2011).

Other: Possible use as an ornamental (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: Known as a grizzly bear, elk and snowshoe hare summer diet component (Reeves 2006).

Livestock: Poor to fair forage value although fairly nutritious until freeze. More commonly grazed by sheep than cattle (Tannas 1997).

Grazing Response: An increaser, spreading readily by rhizomes (Tannas 1997).

Reclamation Potential

Due to natural regeneration by rhizome post-fire, there is a likelihood transplants might be produced from rhizome cuttings. Although generally shade-tolerant, this species is found among others re-establishing post-fire, and therefore should not be unduly stressed in an early seral community. Has been used successfully in the reclamation of construction sites, recreation sites and some mining sites in Denali National Park (Reeves 2006).

Commercial Resources

Availability: Seeds and plants are commercially available in Alberta (ANPC 2010). However, to ensure material is properly adapted, local harvest is preferred.

Notes

Mertensia paniculata is listed as 85% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Walter Siegmund 2013 @ Wikimedia commons.

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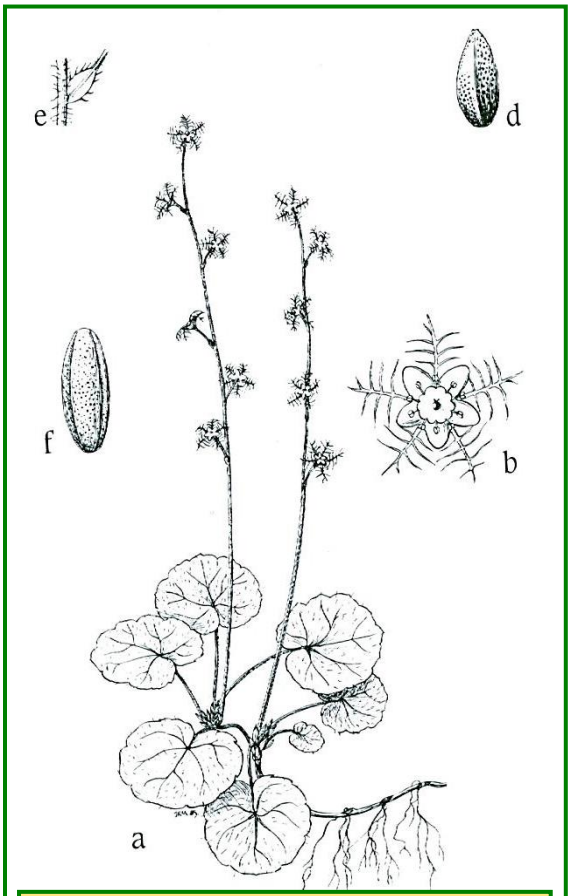
Scientific Name: *Mitella nuda* L. **Family:** *Saxifragaceae*

Common Name: bishop's cap, bare-stem bishop's-cap, miterwort, naked miterwort



***Mitella nuda* a. plant habit including inflorescence, leaves, rhizomes and roots b. flower d. seed e. bract f. pollen**

Plant Description

Erect perennial stoloniferous forb, 3 to 20 cm tall with hairy usually leafless (sometimes 1 leaf) stems; few heart to kidney-shaped leaves at base, 2 to 5 cm across, lobed with sparse stiff hairs on both surfaces; 3 to 10 tiny flowers in a raceme, pale greenish yellow with 5 petals reduced to very thin branched lobes and 5 pale green to white sepals which resemble petals; 10 stamens and 1 pistil (Johnson et al. 1995, Moss 1983).

Fruit: 2 valved greenish capsules 2 to 3 cm long (Wilkinson 1999).

Seed: Shiny black, ovoid seed with smooth surface, 1 mm long often pointed at one end (Moss 1983).

Habitat and Distribution

Found in cool shaded habitats like rich, moist forests, stream banks, wooded swamps, bogs and mossy thickets (Johnson et al. 1995, Rook 2002).

Seral Stage: Mid-successional – found under both conifer dominant (later successional) and deciduous (earlier successional) mixed-wood forests (Qian et al. 2003).

Soil: Rich forest soils (Rook 2002).

Distribution: Found throughout Canada and the northern US (USDA NRCS n.d.).

Southeastern Alaska, southern Yukon, southwestern District of Mackenzie to Hudson bay, northern Quebec, Newfoundland south to Washington, Montana, Saskatchewan, North Dakota, Great lakes, Pennsylvania (Moss 1983).

In Alberta, it is found in the north and central parts of the province (Royer and Dickinson 2007).

Phenology

Flowers bloom May to June, and fruit ripens in late summer (Rook 2002).

Pollination

By mosquitos and *Diptera sp*. (Savile 1975).

Seed Dispersal

Some seeds are ejected when seed cups open. Some fall after drying.

Genetics

2n=14 or 28 (Moss 1983).

***Mitella nuda* in flower**

Seed Processing

Collection: Seeds can be collected into paper bags in early fall when capsules and discs turn tan and are kept in a well ventilated area prior to cleaning (Evans et al. 2004).

Seed Weight: 3,600 seeds/g.

Fruit/Seed by Weight: 0.131 to 0.15 g/500 seeds.

Harvest Dates: Mid to end of July.

Cleaning: Hand cleaned (Evans et al. 2004). Shake seeds off plant, crush plant to remove any remaining seed. May be screened.

Storage Behaviour: Orthodox; seed can be safely dried to low relative humidity and stored frozen (Royal Botanic Gardens Kew 2008).

Storage: Store frozen in hermetically sealed containers (Royal Botanic Gardens Kew 2008).

Longevity: Seed has physiological dormancy (Evans et al. 2008). Seeds lose no viability after one year of dry storage.

Propagation

Natural Regeneration: *M. nuda* germinates and grows best in aspen forest litter (Ahlgren and Ahlgren 1981).

Vegetative propagules are present in understory of clearcut and partially cut mixedwood forests (Qi and Scarratt 1998).

***Mitella nuda* with ripened seeds**

Germination: After cold temperatures, 63% of seeds germinated in 64 to 98 days; 42% of seeds without refrigeration germinating in 48 to 139 days (Nichols 1934).
Pre-treatment: Seeds require no pre-treatment prior to germination.
Direct Seeding: Seed in winter (Rook 2002).

***Mitella nuda* leaf**

Nursery Production: Evans et al. (2008) used the following: pre-planting treatment of 5 month outdoor stratification, followed by direct seeding. Seeds were lightly covered with media (6:1:1 milled sphagnum peat, perlite, and vermiculite with Osmocote controlled release and Micromax fertilizers). Germination occurred in the fall following a 160 day cold-moist stratification and 120 day warm-moist stratification. Media was kept slightly moist during germination. Initial germination occurred after several days of temperatures at 12 to 16°C during the day and 0 to 10°C at night. Root and shoot development occurred rapidly following germination, and 4 to 6 true leaves were evident 3 weeks after germination. Total time to harvest was 2 years.
Vegetative Propagation: From cuttings in late summer (Rook 2002) and after disturbance such as low intensity wildfire (Lee 2004).
Established nursery stock can be increased by divisions (Evans et al. 2004).

Aboriginal/Food Uses

Food: No literature found.

Medicinal: Woods Cree used crushed leaves to treat earaches (Johnson et al. 1995, Royer and Dickinson 1996).

Reclamation Potential

Better suited to later stages of reclamation, after other species have become established, because *Mitella nuda* seeds in the soil seed bank may make use of micro gaps in the herbaceous canopy when germinating (Jankowska-Błaszczuk and Grubb 2006).

Notes

Also known as *Mitella prostrata* (ITIS n.d.).
Mitella nuda is listed as 84% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

***Mitella nuda* seeds**

Photo Credits

Photo 1 and 2: Provided by Derek Goertz of Algoma University.
Photo 3 and 4: Wild Rose Consulting, Inc. 2010.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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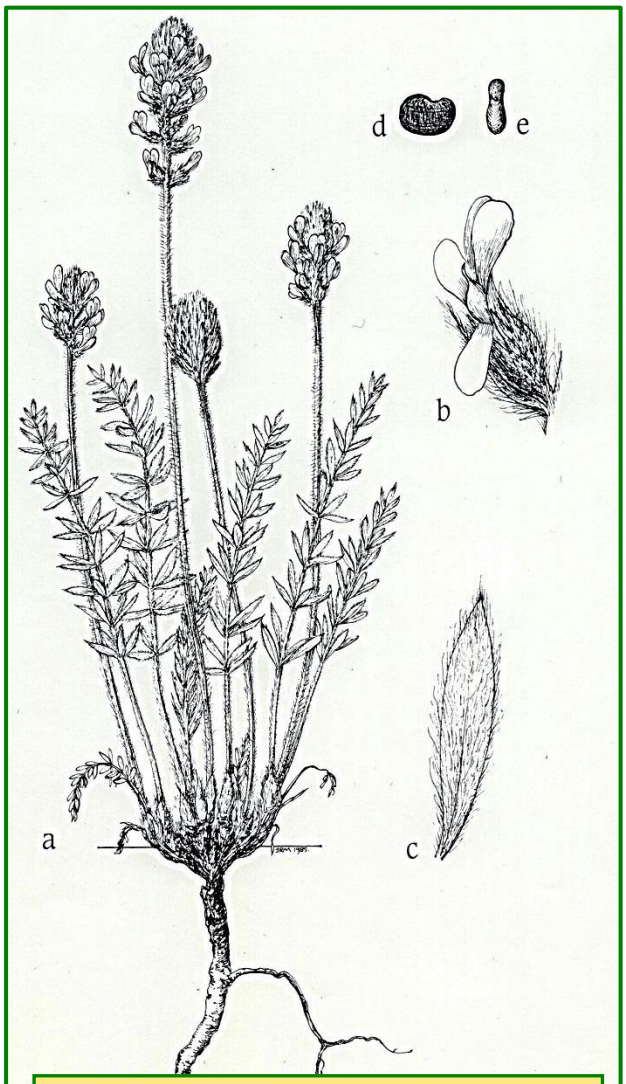
Scientific Name: *Oxytropis splendens* Dougl. ex Hook

Family: *Fabaceae*

Common Names: showy crazyweed, showy locoweed, showy pointvetch



O. splendens **– a. habit: includes inflorescence, leaves flower and roots b. flower c. leaflets d-e. seeds**

Plant Description

Perennial densely hairy silvery plant from a branched caudex and thick taproot; leaves pinnate, with leaflets arising in whorls of 3 to 4; inflorescence is a dense, hairy raceme, with 12 to 35 flowers bluish to reddish purple drying to violet (Pahl and Smreciu 1999).

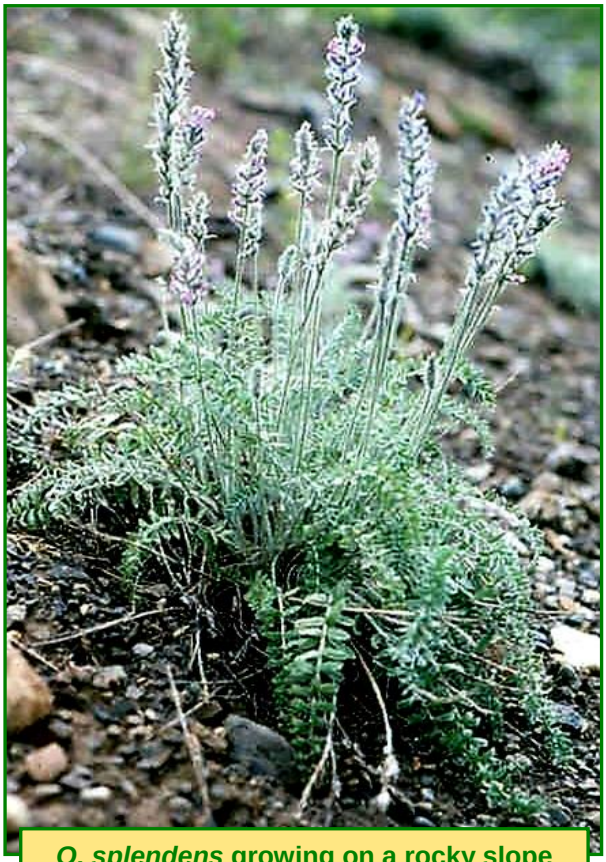
Fruit: Pods ovoid, 10 to 17 mm long, short beaked, densely hairy silver, with a deep groove below (Pahl and Smreciu 1999).

Seed: Kidney shaped 2 to 2.5 mm long, dark brown to black (Pahl and Smreciu 1999).

Habitat and Distribution

Grassy slopes, open woods, gravely river flats, banks and roadsides (Pahl and Smreciu 1999).

Soil: Does well in medium to coarse textures soils



O. splendens **growing on a rocky slope**

with pH ranging from 6.1 to 7.4 (Pahl and Smreciu 1999).

Distribution: Widely distributed in the mountains and foothills in Alberta. Alaska, Yukon, District of Mackenzie, to Lake Superior, south to southeastern British Columbia, New Mexico, North Dakota, northern Minnesota (Moss 1983).

***O. splendens* in flower**

Phenology

Perennial can live 3 to 5 years; flowers from late June to August and September. In cultivation, flowers bloom more than once: first in mid-June to mid-August and the second late August to October (Pahl and Smreciu 1999).

Pollination

Insects (Pahl and Smreciu 1999).

Seed Dispersal

Pods dehisce, scattering seed a few metres.

Genetics

2n=16 (Moss 1983).

Symbiosis

Actively mycorrhizal in prairie grasslands with vesicular-arbuscular mycorrhizae and rhizobial (nitrogen fixing) bacteria (Pahl and Smreciu 1999).

Seed Processing

Collection: Expect the first significant seed crop in the second year after cultivation. Direct combine. For small lots and wild harvest; cut, bag, hang or spread to dry and thresh (Pahl and Smreciu 1999).

Seed Weight: 1.30 g/1,000 seeds (Pahl and Smreciu 1999).

Fruit/Seed by Weight: 770 seeds/g (Pahl and Smreciu 1999).

Harvest Dates: Late July to early August (Pahl and Smreciu 1999).

Cleaning: Remove leafy material with a coarse screen, use a top screen 1/15" round screen and a bottom screen 6 x 26 mesh (Pahl and Smreciu 1999).

Storage Behaviour: Orthodox; dry seed to low relative humidity prior to frozen storage (Royal Botanic Gardens Kew 2008).

Storage: Cool dry conditions (Winslow 2002).

Longevity: Reported to remain viable after 5 to 7 years (Winslow 2002).

Propagation

Natural Regeneration: By seed (USDA NRCS n.d.).

Germination: 100% in 3 to 8 days with pre-treatment, 5 to 10% without pre-treatment (Pahl and Smreciu 1999).

Pre-treatment: Scarification (Pahl and Smreciu 1999).

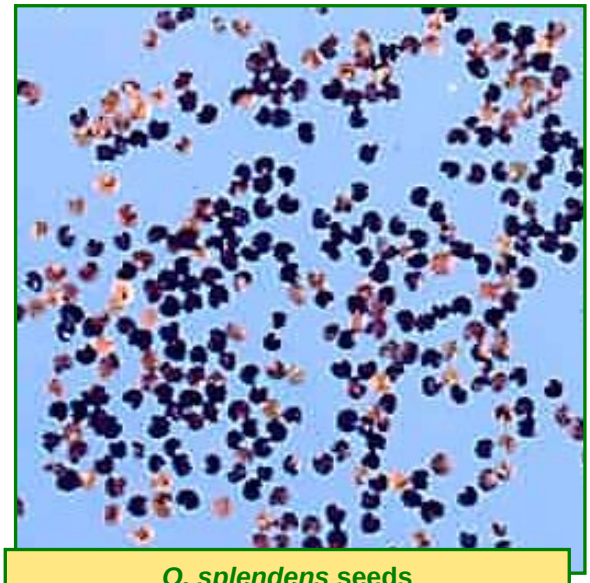
Direct Seeding: Plant seed in the spring at a depth of 0.6 cm, row cropping recommended (Pahl and Smreciu 1999).

Seed Rate: 175 to 200 seeds per linear metre row (Pahl and Smreciu 1999).

Vegetative Propagation: Not propagated vegetatively (USDA NRCS n.d.).

Aboriginal/Food Uses

Oxytropis sp. contains toxic alkaloids as well as taking up selenium making them a poor food species (Mackinnon et al. 2009).



***O. splendens* seeds**

Wildlife/Forage Usage

Wildlife: Is lightly browsed by elk (Pahl and Smreciu 1999).
Livestock: Poor (Tannas 1997).
Grazing Response: Increaser (Tannas 1997).

Reclamation Potential

An early colonizer of disturbed gravel areas; colonizes disturbed sites and unamended coal spoils in the Rocky Mountains (Pahl and Smreciu 1999). Ideal for reclamation sites due to its ability to fix nitrogen.

Commercial Resources

Availability: Available at few nurseries in Alberta (ANPC 2010).
Cultivars: None (Pahl and Smreciu 1999).

Notes

Synonym *Astragalus splendens* (USDA NRCS n.d.).

Photo Credits

Photos 1, 2 & 3: Wild Rose Consulting Inc., 2011.
Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific Name: *Primula pauciflora var. pauciflora* **Family: *Primulaceae***

Common Name: saline shooting star, darkthroat shooting star

***P. pauciflora* in bloom in Fort McMurray, Alberta. Seeds in the lower right hand corner**

Plant Description

An erect perennial forb; flowering stem leafless, glabrous, 5 to 50 cm tall; basal leaves oblanceolate, ovate or spatulate, 4 to 20 cm long with smooth margins; irregular umbel with 3 to 20 stalked flowers, magenta to lavender, 10 to 20 mm long, 5 sepals, 5 recurved petals, 5 stamens with yellow filaments and pollen sacs and 1 pistil (Moss 1983, Royer and Dickinson 2007).

Fruit: Cylindric to ovoid valvate capsule, 5 to 15 cm long (Moss 1983).

Seed: Numerous, tiny brown seeds (USDA NRCS 2010) without a membrane on the edges (eFloras n.d.).

Habitat and Distribution

Found in wet meadows and saline flats (Moss 1983).

Seral Stage: Early to mid-stage (found in saline environments).

Soil: Medium to coarse textured soils, pH between 6.0 and 7.8 and no drought tolerance (USDA NRCS n.d.). Salinity tolerance (Moss 1983).

Distribution: Western and central North America (USDA NRCS n.d.). Southern Alaska, Yukon, western District of Mackenzie to Saskatchewan, southern Manitoba south to California, Arizona, Colorado, Nebraska, North Dakota (Moss 1983). In Alberta, it is found in the southern half and in the northeastern corner (Royer and Dickinson 2007).

Phenology

Plants flower late June to early July (Royer and Dickinson 2007).

Pollination

Flowers of *Primula* species are buzz pollinated, in which pollen-collecting bees (*Bombus* spp.) mechanically vibrate the flowers to extract pollen (Harder and Barclay 1994).

Genetics

2n=44, 88, 132 (Moss 1983).

Symbiosis

No literature found.

Seed Processing

Collection: Cut flowering stems and place in paper bags to dry.

Seed Weight: 0.24 g/1,000 seeds.

Harvest Dates: Late July.

Cleaning: Allow capsules to dry. Shake/crush to remove seed. Winnow (screens or blower) to remove chaff.
Storage Behaviour: Orthodox; seeds may be dried down to 3% to 7% relative humidity and stored at freezing temperatures (Royal Botanic Gardens Kew 2008).
Storage: Stored at freezing temperatures in hermetically sealed containers (Royal Botanic Gardens Kew 2008).
Longevity: Unknown.

***P. pauciflora* basal leaves.**

Propagation

Natural Regeneration: May be able to regenerate one or two years following a single disturbance (e.g., thinning or burning) (Dodson et al. 2007). Generally grows from seed.
Germination: 100% to 85% germination was achieved when seeds where germinated on a 1% agar media at 20°C (8 hrs day / 16 hrs night) with pre-treatments (Royal Botanic Gardens Kew 2008).
Pre-treatment: Royal Botanic Gardens Kew (2008) received the highest germination when seeds where cold stratified for 6 weeks at 0°C. Cold stratification not required (USDA NRCS n.d.).
Five month outdoor cold, moist stratification used to germinate seeds (Evans et al. 2008)
Vegetative Propagation: Propagated from cuttings (USDA NRCS n.d.).

Aboriginal/Food Uses

Food: All parts of this plant are edible; can be eaten raw or roasted, though not often done because the plants provide very little food (Tilford 1997).
Medicinal: Okanagan-Colville and Blackfoot Indians used an infusion of the roots or leaves as a wash or drops for sore eyes (Hellson 1974, Turner et al. 1990) and gargled an infusion of the leaves for cankers (Hellson 1974).
Other: Thompson Indians used the flowers as a pattern for beadwork, and the Okanagan-Colville Indians used crushed flowers to dye arrows pink (Turner et al. 1990).

Wildlife/Forage Uses

P. pauciflora has low palatability to grazing and browsing animals (USDA NRCS n.d.).

Reclamation Potential

As a saline tolerant species, *P. pauciflora* could be very useful in revegetating areas with high electrical conductivity and salt contamination.

Commercial Resources

Harvest Methods: No literature found.
Availability: No literature found.
Cultivars: Red wings (Shoot 2013).
Uses: No literature found.

Notes

Formerly known as *Dodecatheon pulchellum* (Raf) Merrill (ITIS n.d.). Synonym *D. radicatum* is not valid (ITIS n.d.).
This species has considerable morphological variation and variation in ploidy (Suttill and Allen 1992), and there is some debate regarding taxonomy, but currently only 4 subspecies are accepted: *cusickii*, *macrocarpum*, *monanthum* and *pulchellum* (ITIS n.d.).

It has been recently proposed that species of *Dodecatheon* should be moved to *Primula* in the subgenus *Auriculastrum* (Mast and Reveal 2007).

Photo Credits

Photo 1: Wild Rose Consulting, Inc. 2007.
Photo 2: Wikimedia Commons 2009. http://upload.wikimedia.org/wikipedia/commons/d/d5/Dodecatheon_pulchellum_ssp_pulchellum_8.jpg [Last accessed May 27, 2013].

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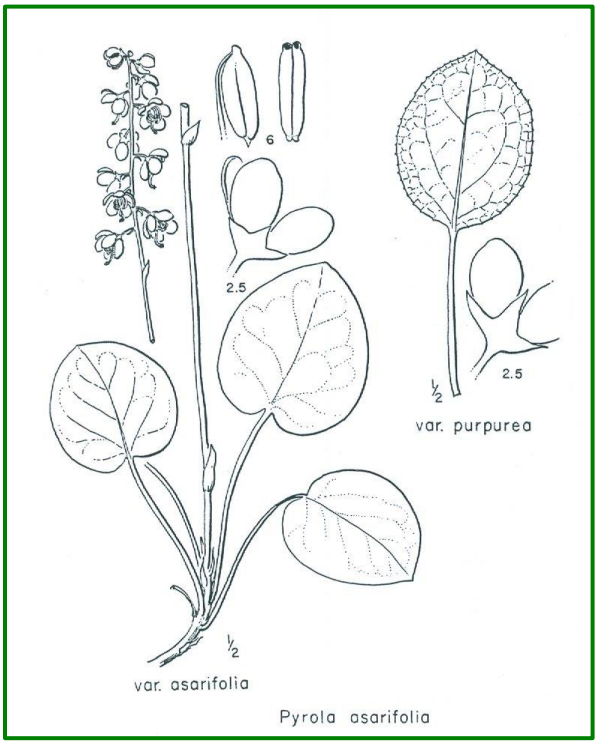
Scientific Name: *Pyrola asarifolia* Michx. **Family:** *Ericaceae*

Common Names: common pink wintergreen, liverleaf wintergreen, shinleaf wintergreen, pink pyrola



Plant Description

Herbaceous perennial evergreen, rhizomatous spread (Haber 1983). Leaf-blades usually shorter than the petioles, 3 to 6 cm long broadly elliptic or round-reniform, commonly cordate at base, with rounded teeth, leathery and shiny above in rosette; leafless flowering stock 15 to 25 cm tall, usually with 1 to 3 scale leaves below the flower; raceme flower, sepals 2 to 3 mm long; petals pale to deep pink, 5 to 7 mm long; anther ends at a sharp stiff point at the lower end, abruptly narrowed above into very short tubes (Moss 1983). Anthers crimson to pale pink – all other Pyrolas have yellow anthers (CYSIP: Botany n.d.).

Fruit: Spherical capsules, 5 chambered, with arching, 5 to 10 mm long style (Johnson et al. 1995).

Seed: Pale or whitish microsperma.

Habitat and Distribution

Moist woods and thickets (Johnson et al. 1995).

Seral Stage: Early (Gucker 2007).

Soil: Prefer moist and acidic soils with a deep LFH layer (Gucker 2007).

Distribution: Alaska, Yukon, southwestern District of Mackenzie to James Bay, Newfoundland south to Oregon, New Mexico, South Dakota, Manitoba, the Great Lakes (Moss 1983).

Phenology
Flowering June through September (Gucker 2007). Retains leaves spring through October (Landhausser et al. 1997).

Pollination
Pyrolaceae are self-compatible and most often pollinated by insects (Knudsen and Olessen 1993).

Genetics
2n=46 (Moss 1983).

Symbiosis
Pyrolaceae form arbutoid associations with basidiomycetes (Robertson and Roberson 1985). Mycorrhizae are required for germination (Hashimoto et al. 2012).

Seed Processing
Collection: Pluck or snip dried capsules and bag.
Seed Weight: 0.007g/1,000 seeds (Royal Botanic Gardens Kew 2008).
Harvest Dates: August.
Cleaning: Due to size of seed, cleaning should occur in the absence of air flow. For best results, break seed capsules at location desired.
Storage Behaviour: Likely Orthodox, seeds should be dried to low relative humidity prior to storage.
Storage: Store cold after drying.
Longevity: No literature found.

Propagation
Natural Regeneration: By seed and rhizome (Plants for a Future n.d.).
Germination: Infrequent (Plants for a Future n.d.). Mycoheterotrophic – requiring fungus *B. sebacinales* for germination (Hashimoto et al. 2012).
Pre-treatment: Seed burial packet of 53 µm nylon net.
Direct Seeding: No literature found.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: Rhizomatous (Gucker 2007).
Micro-propagation: No literature found.
Greenhouse: Dust-like seed is difficult to germinate but may produce plants if sown on sphagnum moss (Lady Bird Johnson Wildflower Center 2007).

Aboriginal/Food Uses
Food: No literature found.
Medicinal: All Pyrolas contain a drug related to aspirin (CYSIP: Botany n.d.).
Leaves can be mashed with lard to stop bleeding and promote healing or chewed to relieve toothaches; boiled with water and mint leaves, it can treat kidney and urinary blockages (CYSIP: Botany n.d.); leaf infusion washes sore eyes; decoction drunk to treat coughing up blood (Marles et al. 2000).
Used as a poultice to mitigate swelling and sores (Gucker 2007).
Used in a decoction to aid in treating sore eyes, coughing up of blood, and liver irritation (Plants for a Future n.d.).

Wildlife/Forage Usage
Wildlife: No literature found.
Livestock: No literature found.
Grazing Response: Decreaser (Gucker 2007).

Reclamation Potential
No literature found.

Commercial Resources
Availability: No literature found.
Cultivars: No literature found.
Uses: No literature found.

Notes
Hybridizes with snowline wintergreen (*P. minor*) in Alberta (Gucker 2007).
Pyrola asarifolia is listed as 79% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Host to spruce cone rust (Gucker 2007).
Polymorphic, with variation according to geographic position – east vs. west and north vs. south (Haber 1983).

Photo Credits

Photo 1: Wikimedia commons 2012.

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Scientific Name: *Rubus chamaemorus* L. **Family:** *Rosaceae*

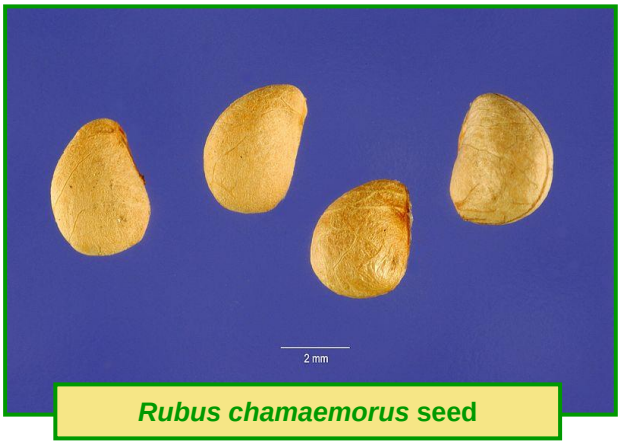
Common Names: cloud berry, bake-apple, baked-apple berry

Plant Description

Perennial herb with creeping rootstock. Upright stems 10 to 30 cm tall, unbranched, prickly. Stems bear 1 to 3 leaves, long petioled, circular to reniform and shallowly 5- to 7-lobed, coriaceous and serrate. Flowers are solitary, long-peduncled and unisexual. Five petals are around 1 cm long, numerous stamens and carpels (Moss, 1983). This is the only Rubus species where the plants are dioecious (one gendered)(CYSIP: Botany n.d.).

Fruit: Compound drupe starts with red tinge but pales as it ripens to yellow, softening (Moss 1983).

Seed: Achene, 4 to 5 mm long (Moss 1983).



***Rubus chamaemorus* seed**

Habitat and Distribution

Sphagnum bogs, usually where only periodically inundated (Moss 1983). Dominant or co-dominant in dwarf-shrub bogs/muskegs.

Seral Stage: Facultative seral species, meaning it is present in recovering early seral sites but more common in later seral stages (Coladonato 1993).

Soil: Organic but relatively dry with sandy subsoils (Lady Bird Johnson Wildflower Center 2011).

Distribution: Found throughout northern Alberta, circumpolar. Alaska, Yukon to southern Baffin Island to Newfoundland south to British Columbia, Alberta, central Saskatchewan, southern Manitoba, Lake Superior, Quebec, Nova Scotia (Moss 1983).

Phenology

Flowers bloom in July with fruit set in August and September (Coladonato 1993).

Pollination

Butterflies and bees (Lady Bird Johnson Wildflower Center 2011).

Dispersal

Seed is dispersed by animals ingesting the fruit (Royal Botanic Gardens Kew 2008).

Genetics

2n=56 (Moss 1983).

Symbiosis

No literature found.

Seed Processing

Collection: Pick fresh berries into containers by hand. Store cool until cleaned.

Seed Weight: 7.4 g/1,000 seeds (Royal Botanic Gardens Kew 2008).

Harvest Dates: Late August or early September.

***Rubus chamaemorus* leaf and berry**

Cleaning: Separate seed from pulp in blender and decant.
Storage: Orthodox (store cold at low relative humidly).
Longevity: No literature found.

Propagation

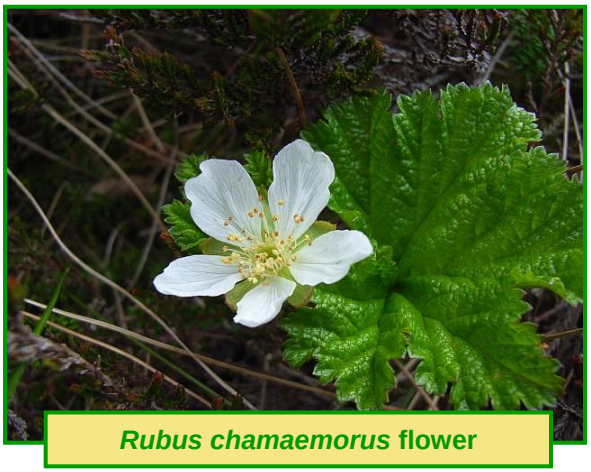
Natural Regeneration: Creeping rootstalk and rhizome (Coladonato 1993).
Germination: Cold stratified seeds germinate at 18°C (Baskin and Baskin 2002).
Pre-treatment: Cold moist stratification for 270 days breaks dormancy (Baskin and Baskin 2002).
Direct Seeding: Sow in autumn (Plants for a Future n.d.).
Seed Rate: No literature found.
Vegetative Propagation: Cuttings can be taken from half-ripe stolons in July/August or plants can be divided in early spring (Plants for a Future n.d.).
Micro-propagation: Plants can be produced from shoots *in vitro* in the presence of 6-benzylaminopurine (BAP), thidiazuron (TDZ) and gibberellic acid (GA3) and were more successful when an airlift bioreactor was used (Debnath 2007).

Aboriginal/Food Uses

Food: Berries are high in water-soluble Vitamin C (Gray 2011) and are edible, fresh or cooked (Borealforest.org n.d., Marles et al. 2000). Berries contain benzoic acid, a natural preservative, which allows them to be stored in a cache for later use (Gray 2011).
Medicinal: Berries are rich in antioxidants and anthocyanins. Leaves can be infused in boiling water to produce a tea for menstrual cramping and diarrhoea. Leaves can also be used as a compress or poultice to treat wounds (Gray 2011).
Used to treat female afflictions such as barrenness and hard labour (Leighton 1985). Roots were used for coughs, fever and consumption (Chandler et al. 1979).
Other: No literature found.

Wildlife/Forage Usage

Wildlife: Moose and caribou browse the leaves and twigs while the flowers and berries attract insects and birds (Coladonato 1993).
Livestock: No literature found.
Grazing Response: No literature found.



***Rubus chamaemorus* flower**

Reclamation Potential

In a review of Syncrude and Suncor plot data, Geographic Dynamics Corp. (2006) found that *R. chamaemorus* did not invade any of the plots. Adapted to survive fire by re-growing from rhizomes, there is a possibility this species will recover and be present in peat transplants (Coladonato 1993). Plant is fire retardant (Dave's Garden n.d.).

Commercial Resources

Availability: No literature found.
Cultivars: No literature found.
Uses: In northern Scandinavia, cloudberries are sold for use in preserves, tarts and other confections. They are also made into a liqueur (Borealforest.org n.d.).
Can be used in a facial steam or in a tonic for oil skin (Gray 2011).

Notes

Rubus chamaemorus is listed as 97% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Steve Hurst USDA-NRCS Plants Database.
Photo 2: Chris 73. Wikimedia Commons.
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Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific name: *Rumex aquaticus* L. **Family:** *Polygonaceae*

Common Names: western dock

Plant Description

Stout glabrous erect perennial herb/forb from taproot; 0.5 to 1.5 m high with a simple red-tinged stem; leaves simple, alternate lower oblong-lanceolate, usually cordate at base and tapering to a narrow tip, 5 to 20 cm long; numerous small greenish to reddish flowers in dense long and narrow clusters on upper 20 to 50 cm of stem, flower stalks are not joined (Johnson et al. 1995).

Fruit: Shiny brown achenes, 2 to 4 mm long, each is enclosed in three reddish-brown, net-veined sepals 5 to 8 mm long (Johnson et al. 1995).

Seed: Dark brown, shiny, three-sided. Each side almost tear drop shaped, 2 mm x 1 mm (Johnson et al. 1995).

***Rumex aquaticus* growing in a meadow**

Habitat and Distribution

Commonly found in moist places (marshes and wet meadows) and waste areas (Moss 1983).

Seral Stage: Early.

Soils: Wet to mesic soils (Gerling et al. 1996).

Distribution: Common across Alberta. Alaska, Yukon, western District of Mackenzie to Hudson Bay, Newfoundland south to California, Nevada, Utah, New Mexico, South Dakota, northern Lake Superior, southern Quebec (Moss 1983).

Phenology

Flowers and seed ripen in June and July.

Pollination

Wind pollinated (IMS Health Incorporated n.d.).

Seed Dispersal

Wind dispersed.

Genetics

2n=160 (Moss 1983).

Seed Processing

Collection: Snip stems and store in breathable containers.

Seed Weight: 0.6622 to 0.9881 g/1,000 seeds (0.8333 g/1,000 seeds average).

Royal Botanic Gardens Kew (2008) reports 2.11 g/1,000 seeds.

Harvest Dates: Late July (Smreciu et al. 2006).

Cleaning: Air-dry fruits/cones. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing. If capsules are intact, merely open capsules and empty seeds.

Storage Behaviour: Orthodox; dry seeds prior to frozen storage (Royal Botanic Gardens Kew 2008).
Storage: Store seed in hermetically sealed containers at frozen temperatures (Royal Botanic Gardens Kew 2008).
Longevity: Seed remains germinable for at least two years after dry storage at room temperatures.

Propagation

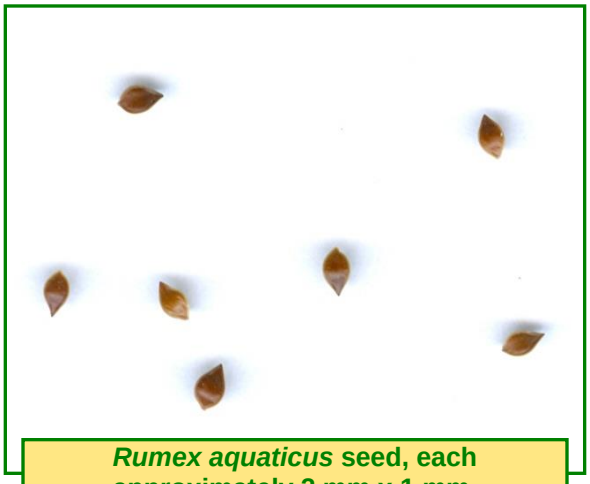
Natural Regeneration: By seeds (Gerling et al. 1996).
Germination: 99% after 30 days using fresh seeds, 100% after 30 days using one-year-old seeds.
Pre-treatment: Four weeks cold stratification (2 to 4°C).
Vegetative Reproduction: No literature found.
Seedling Production: Soak seeds in water for 24 hours, surface sow, use mist and bottom heat (Young 2001).

Aboriginal/Food Uses

Food: Stems of western dock were cooked and eaten. Young stems and leaves were also eaten raw. Ground seeds were added to other foods and the seeds were used as a tobacco stretcher or substitute (Marles et al. 2000).
Medicinal: Boiled whole plants were used to make a wash to treat painful joints (arthritis). Because of their significant amounts of tannin, roots can be chewed and applied to wounds to stop bleeding and promote healing. As a medicine, the root can also be used to treat high blood pressure and heart ailments.
Other: Large taproots were dried, grated and boiled to make a yellow dye (Marles et al. 2000).

Wildlife/Forage Usage

Livestock: Poor forage value, *Rumex* genus is mildly toxic due to its tendency to accumulate oxalates (Tannas 1997).
Grazing Response: Western dock is an increaser and invader. It produces an abundance of seed and spreads when higher quality range plants are depleted because of overgrazing (Tannas 1997).



***Rumex aquaticus* seed, each approximately 2 mm x 1 mm.**

Reclamation Potential

Johnson et al. (1993) investigated the effectiveness of western dock (*Rumex occidentalis*) for dewatering oil sands fine tailings. The plants were able to grow from transplants in tailings in the greenhouse and significantly reduced tailings water content. Field trials were not as successful.

Commercial Resources

Availability: Seed is commercially available in Alberta (ANPC 2010).
Cultivars: None are known.
Uses: Natural dye materials and as scientifically proven medicinal compounds (Marles et al. 2000).

Photo Credits

Photo 1: Courtesy of Walter Siegmund @ wikimedia commons. 2011.
Photo 2: Wild Rose Consulting, Inc. 2012.

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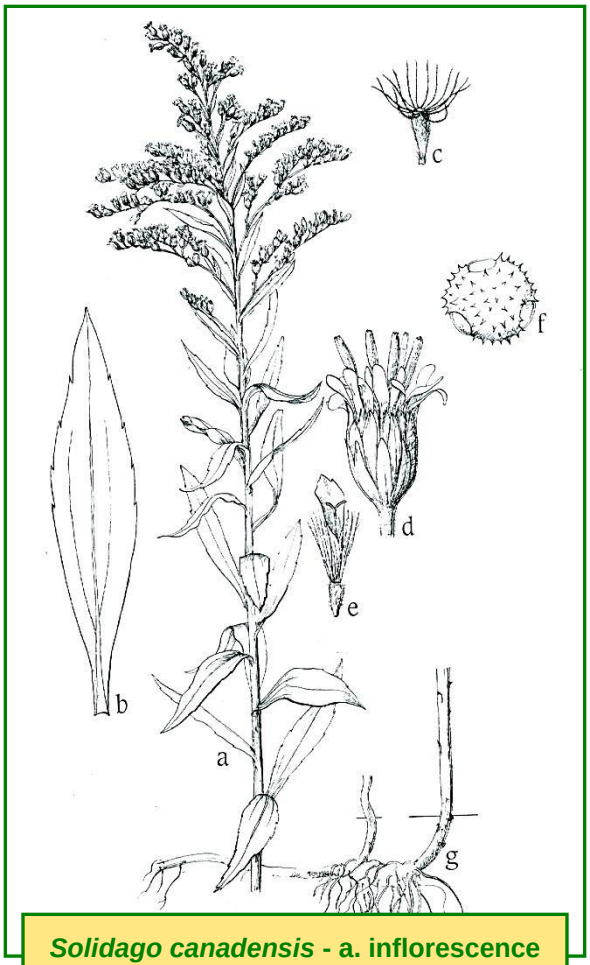
Scientific Name: *Solidago canadensis* L. **Family:** *Asteraceae*

Common Names: Canada goldenrod, common goldenrod



***Solidago canadensis* - a. inflorescence b. leaf c. seed d. single flower head e. floret f. pollen g. rhizome with roots.**

Plant Description

Erect robust perennial herb; slender leafy stems 30 to 90 cm high, pubescent at the summit below the inflorescence, growing from long creeping rhizomes (5 to 12 cm long) that can form large clonal colonies; leaves lanceolate, acuminate, serrate crowded 4 to 7 cm long, three-nerved, rough/hairy above and below, basal and lowest leaves are reduced and soon fall off; numerous small flower heads in narrow or broadly pyramidal terminal clusters on ascending branches; yellow ray flowers (10 to 17) 1 to 3 mm long with 3 to 5 mm high involucres and linear pointed bracts (Moss 1983).

Fruit: Achenes with attached pappus (Pahl and Smreciu 1999).

Seed: Achenes tan brown, hairy, with a pappus of fine white hairs (Pahl and Smreciu 1999).

***Solidago canadensis* in flower.**

Habitat and Distribution

Found in open woods, moist meadows and roadsides, damp thickets, abandoned farmland, and tall-grass prairies. Fairly shade tolerant.

Seral Stage: Early seral; colonizes disturbed sites.

Soils: Tolerant of a wide range of soil fertility and texture however it is most common on moist but not waterlogged soils and rarely on dry sites (Rook 2002).

Can tolerate soil pH ranging from 4.8 to 7.5 and is shade and salt intolerant (USDA NRCS n.d.).
Distribution: Widespread across Canada and USA and scattered north to the Arctic Circle. Alaska, Yukon, southwestern District of Mackenzie to Hudson Bay, Newfoundland south to California, New Mexico, Texas, Florida (Moss 1983).

***Solidago canadensis* inflorescence.**

Phenology

Flowers late July to early August. Seeds mature from late August to October (Pahl and Smreciu 1999). Seeds are gradually dispersed during the autumn and winter months (Coladonato 1993).
Rhizomes are produced in late autumn, lie dormant during the winter months and shoot growth proceeds in the following spring.

Pollination

Insect pollinated (honeybees, bumblebees, soldier beetles and syrphid flies) (Werner et al. 1980).
Cross-pollinating and self-incompatible. 55% pollen viability and no apomixis (Pahl and Smreciu 1999).

Seed Dispersal

Seed borne on pappus for wind dispersal.

Genetics

2n=18, 36, 54 (Moss 1983).

Symbiosis

Associates with *Endogone* sp. (Werner et al. 1980).
Colonized by arbuscular mycorrhizal fungi (Bohrer et al. 2004).
Forms symbiosis with AMF *Glomus constrictum* (more competitive in newly reclaimed sites) and *Glomus mosseae* (more competitive in older reclaimed sites) (Jin et al. 2004).

Seed Processing

Collection: Snip ripe stems.
Seed Weight: 0.085 to 0.1027 g/1,000 seeds (0.0943 g/1,000 seeds average).
Harvest Dates: Late August.
Cleaning: Pull seeds from seed heads or shake free. Rub seeds with pappus between corrugated rubber in a box. Sieve to remove seeds from chaff using 1/25 inch round top screen and 45 x 45 mesh bottom screen. Small chaff and dust can be removed by winnowing (Pahl and Smreciu 1999).
Alternatively, pappus with attached seeds can be placed on a sieve with mesh size large enough to let seeds through and stacked on a sieve that will catch the seeds. Place a smaller sieve over the top sieve and direct a strong flow of air (such as that produced by a reversed vacuum) through the top sieve. Seeds will be removed from the pappus and lodge in the small mesh sieve (Pahl and Smreciu 1999).
Storage Behaviour: Uncertain (Royal Botanic Gardens Kew 2008).
Storage: Store cool in sealed containers (Wick et al. 2008).
Longevity: Up to 5 years (Wick et al. 2008).

Propagation

Natural Regeneration: From seed and creeping rhizomes that grow near the base of the current years shoot after the first year of growth. Each rhizome can

produce a single shoot from its apical tip and each shoot can produce 2 to 6 (or more) daughter rhizomes. This forms a cluster of stems.
Germination: Bradbury (1973) obtained 50% germination after 40 days (seeds collected before the first frost, no pre-treatments).
Werner et al. (1980) obtained 75% germination for seeds collected before first frost and allowed an after ripening period of 90 days.
Pre-treatment: None.
Direct Seeding: Greenhouse and nursery practice is to lightly cover seeds and keep evenly moist for 3 weeks of establishment and 5 weeks of active growth (Wick et al. 2008).
Seeding Rate: USDA NRCS (n.d.) recommends between 11,900 and 25,700 seeds/hectare.
Vegetative Propagation: With rhizome cuttings and by dividing mature plants (Pahl and Smreciu 1999).

***Solidago canadensis* seeds; approximately 3 mm long**

Aboriginal/Food Uses
Food: None known.
Medicinal: Boiled leaves and stems are used to make decoction to treat kidney and bladder problems or constipation. Once cold, the decoction can also be used as a wash to dry weeping sores (Marles et al. 2000).
Used to treat sore throats by mixing mashed leaves and grease. Used as an ingredient for astringents and diuretics and sometimes claimed to treat diphtheria (Royer and Dickinson 1996).
Other: The flower clusters can be used to make a strong yellow dye (Johnson et al. 1995, Royer and Dickinson 1996).

Wildlife/Forage Usage
Wildlife: White-tailed deer graze on it in the late summer and autumn (Coladonato 1993). Browsed by elk and mule deer (Pahl and Smreciu 1999).
The nectar is an important forage source for bees and butterflies and is also attractive to birds (Lady Bird Johnson Wildflower Center 2010).
Livestock: Good to fair palatability for cattle, sheep and horses (Coladonato 1993).
Grazing Response: Increaser; ability to spread readily by its vigorous rhizome growth (Tannas 1997).

Reclamation Potential
Solidago canadensis is a pioneer invader following disturbances (Coladonato 1993).
Has been shown to tolerate high heavy metals and moderate salt concentrations on a former cokery site (Immela et al. 2012).
It has aggressive vigorous rhizome growth which is recommended for re-vegetation of disturbed sites (provided there are good soil and moisture conditions) (Tannas 1997). It provides rapid and complete cover for erosion control (Pahl and Smreciu 1999).

Commercial Resources
Availability: Seed is commercially available in Alberta (ANPC 2010).
Cultivars: No known cultivars.
Uses: Essential oil for aromatherapy, dried herb and flower arrangements. Grown widely in western Europe for ornamental purposes (Werner et al. 1980), and to produce different shades of dye (Coladonato 1993).

Notes
S. canadensis can become a considerable invader in poorly managed pasture, and a pest in forest nurseries

and in perennial gardens and crops (Werner et al. 1980).

Goldenrod responds positively and is generally enhanced following low to moderate-severity fires because of its soil-stored seed and underground rhizomes (Coladonato 1993).

Unlike popular belief that *Solidago* species are the main cause of late summer hay fever, according to a study based out of New York, the atmospheric pollen of *Solidago* averaged only 1% to 2% of the total pollen caught. Other allergenic plants such as ragweeds are more abundant and prolific and contribute more to the hay fever syndrome.

S. canadensis has three microorganisms (powdery mildew, root rot and needle blister rust of pine) that are pathogenic to economically important plants (Werner et al. 1980).

Photo Credits

Photo 1: T.Voekier, http://species.wikimedia.org/wiki/Solidago

Photo 2: G.Slickers, http://upload.wikimedia.org/wikipedia/commons/2/26/Solidago_canadensis_20050815_248.jpg

Line Diagram: John Maywood, used by permission of Bruce Peel Special Collections, University of Alberta.

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Scientific name: *Solidago simplex* var. *spathulata* DC Cronq.
Family: *Asteraceae*

Common Names: mountain goldenrod, spike-like goldenrod, sticky goldenrod

Plant Description

Erect, resinous, aromatic perennial with solitary or tufted stems, often reddish, from short stout rhizomes, 10 to 40 cm high; decumbent at base; basal leaves broadly lanceolate or oblanceolate, rounded at apex, somewhat crenate towards tip, 1-veined, 2 to 10 cm long, smaller upper leaves; racemose heads 8 mm high in dense, often interrupted clusters forming a long narrow cylinder at stem tip; flowers yellow (usually eight ray and 13 disc flowers); involucres 4 to 6 mm high, 5 to 7 mm wide; bracts linear-oblong to oblong, obtuse (Moss 1983).
Fruit/Seed: Densely hairy achenes approximately 2 mm long (Johnson et al 1995). Ensiform seed, light brown in colour when they are mature (Young 2001).

Habitat and Distribution

Seral Stage: Grassland, open woods to alpine elevations, meadows, riverbanks, terraces, prairies, parklands, and southern boreal forests (Moss 1983).
Soils: Mesic.
Distribution: Widespread across Alberta. Alaska, Yukon, western District of Mackenzie to Manitoba south to California, Arizona, New Mexico (Moss 1983).

Phenology

Flowers yellow through July and August (eFloras n.d.). Seed dispersed in late August, early September.

Pollination

Insect pollinated.

Seed Dispersal

Seed born on pappus and easily spread by wind.

***Solidago simplex* in open mixed woods.**

Genetics

2n=18, 36 (Moss 1983).

Symbiosis

No literature found.

Seed Processing

Collection: Cut heads and place in breathable container or bag.

Seed Weight: 0.1162 g/1,000 seeds.
Harvest Dates: Late August.
Cleaning: Pull seeds from seed heads by hand. Rub seeds with pappus between corrugated rubber in a box. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing.
Alternatively, pappus with attached seeds can be placed on a sieve with mesh size large enough to let seeds through, over one to catch the dropping seeds. Place a smaller sieve over the top sieve and direct a strong flow of air (such as that produced by a reversed vacuum) through the top sieve. Seeds will be removed from the pappus and lodge in the small mesh sieve.
Storage Behaviour: Orthodox; dry seed prior to freezing (Royal Botanic Gardens Kew 2008).
Storage: Keep seeds dry and cool (Young 2001).
Longevity: Germination percentages decline after two years when stored dry at room temperatures.

Propagation

Natural Regeneration: Reproduces primarily by rhizomes, and to a lesser extent by seeds (Gerling et al. 1996).
Germination: Over 50% - 75% germination in fresh and year old seeds (Butler and Frieswyk 2001, Young 2001). Seeds germinate 4 to 30 days (Butler and Frieswyk 2001, Young 2001).
Seeds considered non-dormant (Baskin and Baskin 2001).
Have been found to germinate better when seed is exposed to light (Baskin and Baskin 2001).
Optimal germination temperature was found to be 24°C/10°C (Baskin and Baskin 2001).
Pre-treatment: None are required (Baskin and Baskin 2001).
Direct Seeding: Seeds can be sown into flats and lightly covered. Emergence observed after one month (Young 2001).
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: By division.

Solidago simplex seed, each approximately 2 mm long.

Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: No known uses.
Medicinal: Boiling the whole plant to make a medicinal tea used to clean wounds, sores, and ulcers on humans, and saddle sores on horses. Less concentrated teas were taken internally to relieve sore throats, throat constrictions, nasal congestion and to promote perspiration. Once ground and dried, the leaves were used as an antiseptic powder on infections. Herbalists have been using goldenrod tea for many years to relieve intestinal gas and cramps. Pharmacologists agree with the benefits of this use. (Marles et al. 2000).
Other: Natural rubber can be found in small quantities in the sap of all goldenrods (Marles et al. 2000).

Wildlife/Forage Usage

Wildlife: No literature found.
Livestock: Low to poor forage value (Gerling et al. 1996).
Grazing Response: Increaser (Gerling et al. 1996).

Reclamation Potential

Have emerged and are reproducing in revegetation trials in northeastern Alberta (Smreciu et al. 2012).

Commercial Resources

Availability: Plants and seed are available in Alberta (ANPC 2010).
Cultivars: None known.

Photo Credits

Photo 1: Allan Carson, University of Northern British Columbia, British Columbia.
Photo 2: Wild Rose Consulting, Inc.

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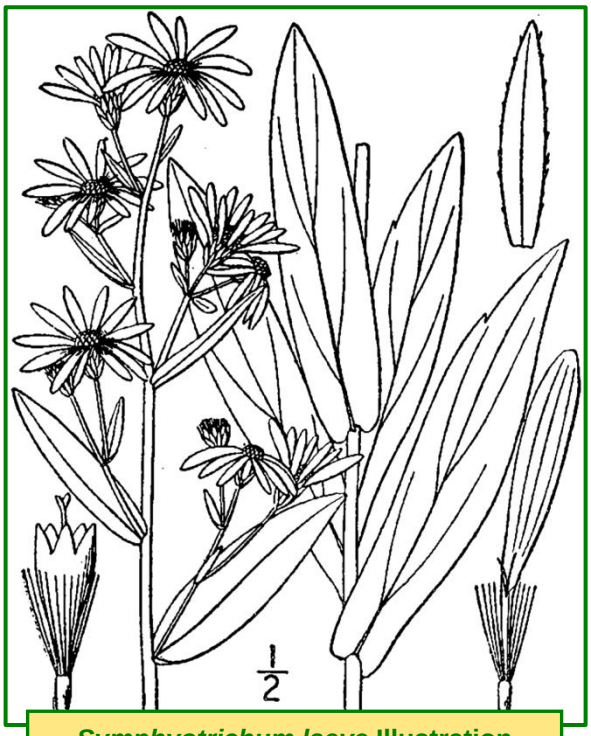
Scientific Name: *Symphyotrichum laeve* (L.) Á. Löve & D. Löve
Family: *Asteraceae*

Common Names: smooth aster, smooth blue aster, purple aster



***Symphyotrichum laeve* Illustration**

Habitat and Distribution

Dry open grasslands and moist sandy forests (Sullivan 1992).

Seral Stage: Occurs at all seral stages. Very common as a colonizer of disturbed sites (Sullivan 1992).

Soil: A wide variety of soil types mesic to xeric (Sullivan 1992).

Distribution: British Columbia to Ontario, southern Quebec south to Washington, New Mexico, Kansas, Missouri, Georgia, Connecticut (Moss 1983).

Phenology

Flowers from approximately the beginning of July to the end of August. Seed is harvested the middle of September (Wick et al. 2008).

Pollination

Flies, butterflies, bees.

Seed Dispersal

Seed born on pappus and easily spread by wind.

Plant Description

Perennial with short rootstocks; stems mostly 30 to 100 cm tall, hairless; leaves numerous alternate, oblong to lance shaped, 2 to 10 cm long, 10 to 45 mm wide; lower leaf stalks are winged, upper leaves stalkless and clasping at the stem; margins smooth to toothed; inflorescence borne in panicle 2 to 3 cm across; disc florets numerous, yellow; ray florets 15 to 25, blue or purple; bracts are sharp pointed, green with a white base, borne in two or more overlapping rows (Royer and Dickinson 2007).

Fruit: Achenes, pappus of pale brown capillary bristles (Royer and Dickinson 2007).

Seed: The fruit is a one-seeded achene (Sullivan 1992, Wick et al. 2008).

***Symphyotrichum laeve* flowers**

Genetics

2n=48 (Moss 1983).

Symbiosis

None known.

Symphyotrichum laeve seed

Seed Processing

Collection: Mature heads may be broken off or cut and placed in breathable bags.

Seed Weight: 0.20 g/1,000 seeds. Wick et al. (2008) weighed seed at 0.41 g/1,000 seeds.

Harvest Dates: Seed was collected in Alberta from Mid-August early September.

Cleaning: Seeds are hand collected when achenes separate easily from the receptacle. Seeds are tan at maturity. Seeds are collected in paper bags and kept in a well-ventilated drying shed prior to cleaning (Wick et al. 2008).

Storage Behaviour: Orthodox; seed may be dried down to 15% relative humidity prior to extended storage under freezing temperatures (Royal Botanic Gardens Kew 2008).

Storage: At 3 to 5°C in sealed containers (Wick et al. 2008).

Longevity: Seed longevity is up to seven years at storage conditions stated above (Wick et al. 2008).

Soil seed banking of this species is not apparent (Sullivan 1992).

Propagation

Natural Regeneration: Primarily by seed as well as short rhizomes (Sullivan 1992). Moderate spread by seed (ALCLA Native Plants n.d.).

Germination: Seed germinates 80% to 100% in 10 to 15 days at 22°C. Germination to true leaf stage is seven to 15 days. Seedlings are thinned at this stage (Wick et al. 2008).

Unstratified seed takes between 7 to 20 days to germinate (Sullivan 1992).

Pre-treatment: Cold, moist stratification. Mix seed with moist but not wet, sterile growing medium (Wildflower Farm, Inc. n.d.). Place mixture in a labeled, sealed plastic bag and store in refrigerator for six to eight weeks; some seed may germinate in the storage bag if moist stratified too long. If sprouting occurs, plant immediately (Wildflower Farm, Inc. n.d.).

Another method is to sow seed outdoors in late autumn so that they may overwinter (Wildflower Farm Inc. n.d.).

Stratification lengths used have varied from 75 days to five months on high elevation seed sources and was not necessary for lower elevation sources (Wick et al. 2008). Containers filled in late fall and irrigated thoroughly prior to winter stratification, covered with a light layer of material (milled sphagnum, peat, perlite and vermiculite with Osmocote controlled release fertilizer) yielded reasonable emergence (Wick et al. 2008).

Wild Rose Consulting, Inc. found no pre-treatment necessary on seeds collected in northeastern Alberta.

Direct Seeding: Wild Rose Consulting found an average of 1% emergence from fall sown seed on three reclaimed sites in northeastern Alberta.

Seed Rate: 11 g seed/m^2 (Sullivan 1992).

Vegetative Propagation: No literature found.

Micro-propagation: No literature found.

Aboriginal/Food Uses

Medicinal: The root can be chewed to treat toothaches and the pain of teething, and can be made into tea to treat fevers (induces sweating) and to help the organs of women to return to normal function after childbirth (Marles et al. 2000).

***Symphyotrichum laeve* adult plant**

Wildlife/Forage Usage

S. leave have high nutrient contents that decrease as they mature throughout the growing season (Sullivan 1992).

Wildlife: Grazed by white tailed deer (Sullivan 1992).

Livestock: Grazed by livestock (Sullivan 1992).

Grazing Response: Decreaser (Sullivan 1992). Plants damaged by grazing respond with increased growth the following season (Sullivan 1992).

Reclamation Potential

Has been used to revegetate ditches along the sides of roads and highways and it is also recommended to be seeded or planted to reclaim native mixed-grass and tall-grass prairie sites (Sullivan 1992).

Commercial Resources

Availability: Available from Alberta nurseries (ANPC 2010).

Cultivars: Bluebird, Purple burst, Kurts, Calliope, Geyer's Aster (Dave's Garden n.d.). These cultivars are not suitable for use in reclamation.

Uses: As a garden ornamental (ANPC 2010).

Notes

Synonym: *Aster laevis* (Budd and Best 1969, ITIS n.d.).

Photo Credits

Photo 1: Walter Muma @ Ontariowildflowers.com 2011.

Photo 2: Prairie Moon Nursery 2011.

Photo 3: Walter Muma @ Ontariowildflowers.com 2011.

Line Drawing: Britton, N.L. and A. Brown 1913 @ Wikimedia Commons.

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Scientific Name: *Symphyotrichum puniceum* var. *puniceum* (L.) Á. Löve & D. Löve

Family: *Asteraceae*

Common Names: purple stem aster

Symphyotrichum puniceum **illustration a. petal b. seed c. pappus d. empty seed head e. rhizome**

Plant Description

Perennial herb growing from thick rhizome, stout stem 0.5 to 1.5 m high, reddish purple, simple or branching above, with spreading hairs; alternate lanceolate to oblong leaves 6 to 16 cm long, 1 to 2 cm wide, sessile, distantly serrate or occasionally entire, hairy beneath and hairy leaf midribs; numerous flower heads in leafy cluster, 30 to 60 ray flowers blue to purplish 8 to 16 mm long, disc flowers yellow; slender loose bracts, involucres 6 to 12 mm high (Moss 1983).

Fruit/Seed: Hairy achenes with white pappus hairs.

Habitat and Distribution

Fairly common in swamps and marshy ground (Moss 1983). Found in wet, grassy roadside ditches. Moderately shade tolerant.

Seral Stage: Mid-successional species.

Soil: Requires moist soil and can grow in nutritionally poor, light to heavy textured soils (Plants for a Future, n.d.).

Distribution: Fairly common in boreal forest, across prairies; north to Lake Athabasca. Alberta to Newfoundland south to South Dakota, Kansas, Iowa, Illinois, Alabama, Georgia (Moss 1983).

Phenology

Flowers from July to November. Seeds ripen in August through September. Late flowers often fail to produce seeds due to a lack of pollination.

Symphyotrichum puniceum **in flower**

Pollination

Flowers are pollinated by bees, flies, beetles and Lepidoptera (moths and butterflies).
Purple stem aster is self-fertile (Plants for a Future n.d.).

***Symphyotrichum puniceum* seed**

Seed Dispersal

Seed born on pappus and easily spread by wind.

Genetics

2n=16 (Moss 1983).

Seed Processing

Collection: Hand pick; entire stems can be cut and dried to allow additional seed ripening.
Seed Weight: 0.14 to 0.23 g/1,000seeds (0.19 average).
Harvest Dates: August in northeastern Alberta.
Cleaning: Pull seeds from seed heads by hand. Rub seeds with pappus between corrugated rubber in a box. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing.
Alternately, pappus with attached seeds can be placed on a sieve with opening size large enough to let seeds through stacked on a sieve that will catch the seeds. Place a smaller sieve over the top sieve and direct a strong flow of air (such as that produced by a reversed vacuum) through the top sieve. Seeds will be removed from the pappus and lodge in the small mesh sieve.
Storage Behaviour: Orthodox; seeds can be dried, without damage, to low moisture contents, and their longevity increases with reductions in both moisture content and temperature (Royal Botanic Gardens Kew 2008).
Storage: 79% viability following drying to 15% moisture content and freezing for 31 days at -20°C (Royal Botanic Gardens Kew 2008).
Longevity: Some germination has been recorded in six-year-old seeds stored at room temperatures.

Propagation

Natural Regeneration: Spreads slowly by seed and by rhizomes (ALCLA Native Plants n.d., USDA NRCS n.d.).
Germination: 25% germination in 30 days with fresh, 1 or 2 year old seed from northeastern Alberta. 75% germination on 1% agar media germinated at temperatures of 25°C in 8 hrs of light and 16 hours dark (Royal Botanic Gardens Kew 2008).
Pre-treatment: 30 days cold stratification.
Direct Seeding: No literature found.
Vegetative Propagation: Can be propagated by division in spring or autumn (Plants for a Future, n.d.). Leafy rhizome cuttings survive well when planted on a moist reclaimed site in northeastern Alberta (Smreciu, et al 2008).
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: No literature found.

Medicinal: Aboveground parts are dried and boiled to make a decoction to treat kidney problems, chills and cold sweats when drunk repeatedly. If collected when plants are in flower, the stems, leaves and flowers can be used to treat headaches. Dried roots can be mixed with tobacco or made into a powder and inhaled to treat headaches or chewed and applied to sore teeth. Roots can be used as a heart medicine, a diuretic, emetic tea, medicine for sore kidneys, fever, teething sickness, failure to menstruate, recovery after childbirth and facial paralysis. Purple stem aster has proven anti-inflammatory properties (Marles et al. 2000).

Reclamation Potential

Spreads rapidly and forms large colonies in wet meadows and ditches of northeastern North America (Taylor and Hamblin 1976).

Commercial Resources

Availability: Occasionally small amounts of seed are offered by nurseries or seed producers in Alberta.

Cultivars: None are known.

Notes

Synonym *Aster puniceus* L.

Symphyotrichum puniceum is listed as 96% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

Photo 1: Robert H. Mohlenbrock. 1995 @ USDA NRCS.

Photo 2: Prairie Moon Nursery 2013.

Line drawing: Christiaan Sepp @ Wikimedia commons 2013.

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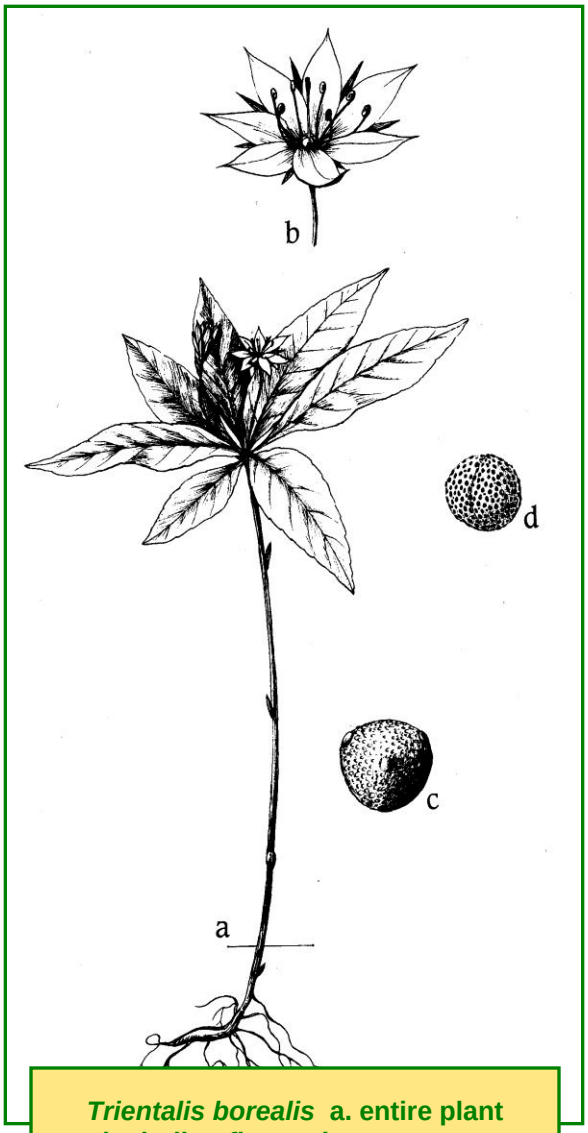
Scientific name: *Trientalis borealis* Raf. **Family:** *Primulaceae*

Common Names: northern starflower



Trientalis borealis **a. entire plant including flower, leaves, stem, rhizome and roots b. flower detail c. pollen d. seed.**

Plant Description

Perennial herb, erect stems 6 to 18 cm high, glabrous or minutely glandular, from slender creeping rhizomes, approximately 30 cm long; leaves are thin lanceolate, acuminate 3 to 10 cm long, in whorls of 5 to 9 at stem tip, sessile or short-petiolate, entire or finely crenulated; single (or sometimes up to three) white flowers 8 to 14 mm wide on slender stalks from center of leaf cluster; ovate or lanceolate 5 to 9 petals, long acuminate (Moss 1983).

Fruit: Spherical, five-chambered dry, brown capsules, 2.2 mm in diameter (Anderson and Loucks 1973).

Seed: Seeds are 7.5 mm long and 7.5 mm wide, brown in colour with a thick, very white outer coat with small spots.

Habitat and Distribution

Found in moist woods. Shade tolerant.

Seral Stage: Mid to late seral.

Soils: Sandy, acidic soil with pH 5 to 6 (Rook 2002).

Distribution: Across boreal forest of prairie provinces and the northern conifer hardwoods in the USA, and from the east coast west to Great Slave Lake (Anderson and Loucks 1973).

British Columbia, Alberta to northern Quebec, Newfoundland south to California, Idaho, Saskatchewan, southern Manitoba, Great Lakes, Georgia, Virginia; Yukon (Moss 1983).

Trientalis borealis **in its natural habitat.**

Phenology

Flowers May to early June; fruit ripens in July; rhizomes are initiated in June to end of July; tubers start to form during the second and third week of July or early August (Anderson and Loucks 1973).

Pollination

Pollinated by bumblebees (Rook 2002), syrphid flies and solitary bees (Anderson and Beare 1983). Self-incompatible with 83% fruit set when cross-pollinated and only 2% fruit set when self-pollinated (Anderson and Beare 1983).

Seed Dispersal

Unknown. Likely scattered by passing animals, brushing seed from stems.

Genetics

2n=96 (Moss 1983).

***Trientalis borealis* seed. Approximately 7 mm.**

Seed Processing

Collection: Collect by hand in the spring.
Seed Weight: 0.4273 g/1,000 to 0.533 g/1,000 seeds on average (Royal Botanic Gardens Kew 2008).
Average Seed/Fruit: 2 to 14 seeds per capsule (Anderson and Loucks 1973).
Harvest Dates: Although seeds ripen in late August the capsules are extremely tiny and difficult to spot. It is best to wait for the following spring, when snow melts. Harvest prior to the undergrowth greening when the whitish-blue capsules stand out above other vegetation.
Cleaning: Air-dry fruits and cones. Crush material or remove large chaff and crush remaining material. Sieve to remove seeds from chaff using appropriate size screens. Small chaff and dust can be removed by winnowing. If capsules are intact, merely open capsules and empty seeds. Sieve or winnow to remove chaff and dust.
Storage Behaviour: Likely orthodox: seed can be dried prior to cold storage.
Storage: Seed should be stored in airtight containers at freezing temperatures.
Longevity: Six year old seed retains some viability (WRC 2012).

Propagation

Natural Regeneration: By seed but primarily by rhizomes (Rook 2002).
Germination: In their study, Anderson and Loucks (1973) obtained these results: 75.5% germination after 40 days at room temperature with no treatment, and 84.2% germination in 90 days at room temperature following 90 days cold stratification (0 to -1°C). They found that seeds germinated better on sand than filter paper.
Germination was slow, requiring up to eight weeks (Baskin and Baskin 2001).
Optimum germination temperature for fresh and stratified seed was found to be 20/10°C (Baskin and Baskin 2001).
Pre-treatment: 8 to 12 weeks warm stratification. Baskin and Baskin (2001) found that no stratification was required in one trial.
Direct Seeding: No literature found.
Planting Density: No literature found.
Seed Rate: No literature found.
Vegetative Propagation: By division in early spring (Rook 2002).
Micro-propagation: No literature found.

Aboriginal/Food Uses

Food: Inedible.
Medicinal: Steeping the whole plant in boiling water would make a medicinal tea to treat general sickness.

Commercial Resources

Availability: Seed is commercially available in Alberta (ANPC 2010).
Cultivars: None are known.
Uses: No literature found.

Notes

Synonym: *Trientalis americana* (Rook 2002).
Trientalis borealis is listed as 89% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).
Can be very slow to establish, but spreads to form colony after several years (Rook 2002).

Photo Credits

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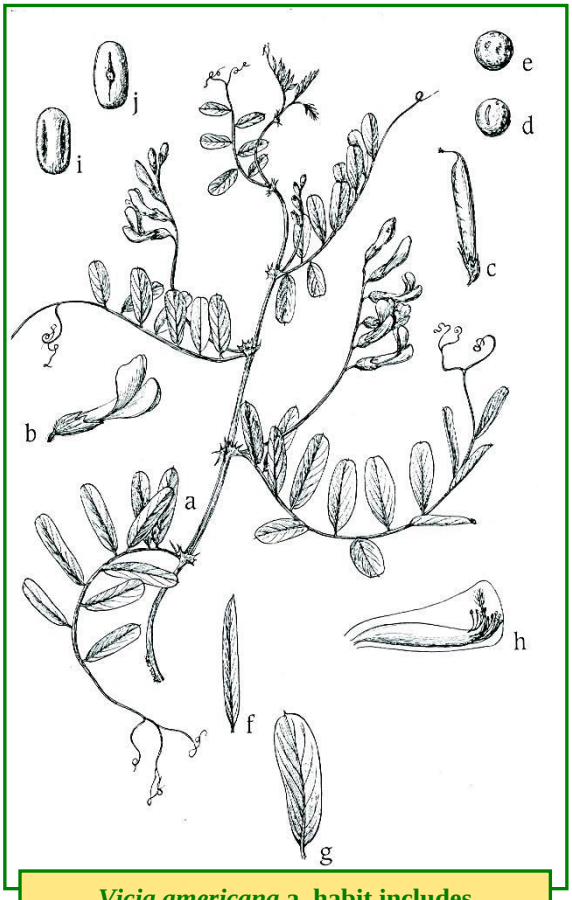
Scientific Name: *Vicia americana* Muhl. **Family:** *Fabaceae*

Common Names: peavine, wild pea, American vetch, wild vetch



***Vicia americana* a. habit includes inflorescence and leaves b. flower c. seed pod d, e. seeds f, g. leaflets h. flower (cut-away) i, j. pollen.**

Plant Description

Perennial herb with stems 30 to 100 cm high, climbing and spreading, often in tangled masses; leaflets 8 to 14, highly variable in size and shape, commonly elliptic to oblong, glabrous or pubescent, entire or sharply toothed towards the apex, the latter acute or truncate, often with an extended point; tendrils well-developed, forking; stipules commonly semi-sagitate, sharply toothed; racemes shorter than the subtending leaves, lax, with 3 to 9 reddish purple flowers, drying bluish (Moss 1983).

Fruit: 3 cm long, flat, glabrous pod.

Seed: 4 to 5 mm, spherical to elliptic, black to olive green, smooth (Pahl and Smreciu 1999).

Habitat and Distribution

Often found in open woods and meadows. Disturbances and agricultural land are also suitable habitat (Pahl and Smreciu 1999).

Seral Stage: Generally found in early seral stages but can persist to later stages.

Soils: Medium to coarse textured soils are best suited for *V. americana* (Gerling et al. 1996).

Soil pH of 5.9 to 7.2 (USDA NRCS n.d.).

Distribution: Common throughout most regions of Alberta, although not common at higher elevations (Pahl and Smreciu 1999).

Phenology

Long-lived, cool-season perennial; flowers throughout spring and summer (June, July and August); seeds mature from July through September (Pahl and Smreciu 1999).

***Vicia americana* as found in the wild.**

***Vicia americana* in flower.**

Pollination

Insect pollinated (Pahl and Smreciu 1999).

Seed Dispersal

Seed scattered by dehiscent fruit, spraying seed a short distance (<5 m). Some animal dispersal.

Genetics

2n=14 (Moss 1983).

Symbiosis

Currah and Van Dyk (1986) reported root associations with vesicular arbuscular mycorrhizae. Also associated with rhizobial bacteria (Pahl and Smreciu 1999).

Seed Processing

Collection: Collect pods by hand into paper bags.
Seed Weight: 14.4 g/1,000 seeds (Gerling et al. 1996). 60 PLS/g (Hammermeister 1998).
Average Seeds/Fruit: 4 to 7 (Plants for a Future n.d.).
Harvest Dates: Late July or early August.
Cleaning: Crush and screen material; winnow to remove remaining chaff. Use 8.5/64" round top screen with 1/15" round bottom screen (Pahl and Smreciu 1999).
Storage Behaviour: Orthodox (Royal Botanic Gardens Kew 2008).

***Vicia americana* seed, approximately 5 mm in diameter**

Storage: Royal Botanic Gardens Kew (2008) suggests orthodox storage behaviour, i.e., seed can be dried

without damage and thereby increase longevity over a wide range of storage environments.
Longevity: No literature found.

Propagation

Natural Regeneration: From seed and vegetatively from creeping rhizomes (Coladonato 1993).
Germination: 78% in 3 to 7 days if scarified; 75% in 14 days without scarification (Pahl and Smreciu 1999).
Pre-treatment: Mechanical scarification.
Direct Seeding: Some emergence has been observed from directly sown seed in northeastern Alberta.
Planting Density: No literature found. Direct seeding recommended.
Seeding Rate: 100 to 150 seeds/m at 1 cm depth (Pahl and Smreciu 1999).
Vegetative Propagation: Rhizome cuttings are suggested by Pahl and Smreciu (1999).

Aboriginal/Food Uses

Food: Young shoots may be cooked and eaten. The tender seeds, mature seeds and immature pods can all be used in cooking (Plants for a Future n.d., Royer and Dickinson 1996). Some sources have indicated the seeds may be poisonous (Royer and Dickinson 1996).
Medicinal: Leaves can be applied to spider bites, or an infusion of crushed leaves in a bath can treat soreness (Plants for a Future n.d.).

Wildlife/Forage Usage

Wildlife: Excellent forage value (Gerling et al. 1996).
Livestock: High nutritional levels, protein content averaging 20% in the summer (Tannas 1997).
May aid in success of associated shrubs (Schellenber and Banerjee 2002).
Grazing Response: A decreaser, disappearing from abused rangeland due to both high palatability and poor resistance to close grazing and trampling (Tannas 1997).

Reclamation Potential

Provides some erosion control (Gerling et al. 1996), colonizes disturbed sites (Pahl and Smreciu 1999), and highly drought tolerant (USDA NRCS n.d.).
Has been established on disturbed alpine rangelands and used on revegetated coal-mines and road sides (Coladonato 1993).
As a legume it has good nitrogen fixation potential for improving soil nutrient conditions (BrettYoung n.d.).

Commercial Resources

Availability: Seed is commercially available from a few sources in Alberta (ANPC 2010).
Cultivars: None are known.
Uses: The stem can be used for string (Plants for a Future n.d.).

Notes

Vicia americana is listed as 92% intact (less occurrences than expected) in the Alberta oil sands region (Alberta Biodiversity Monitoring Institute 2014).

Photo Credits

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