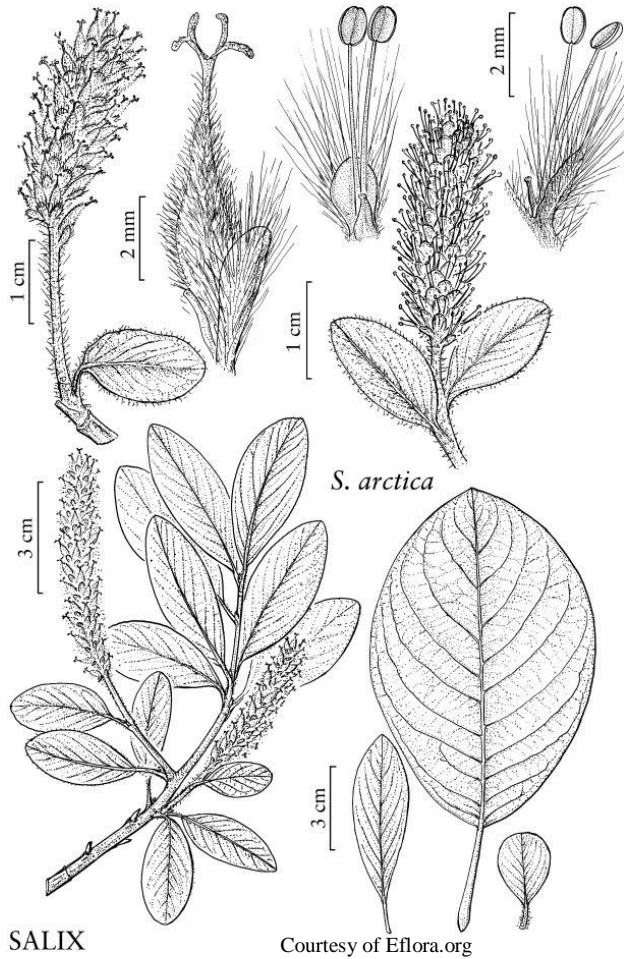


Plant Propagation Protocol [updated] for *Salix Arctica*

ESRM 412 – Native Plant Production

Spring 2012



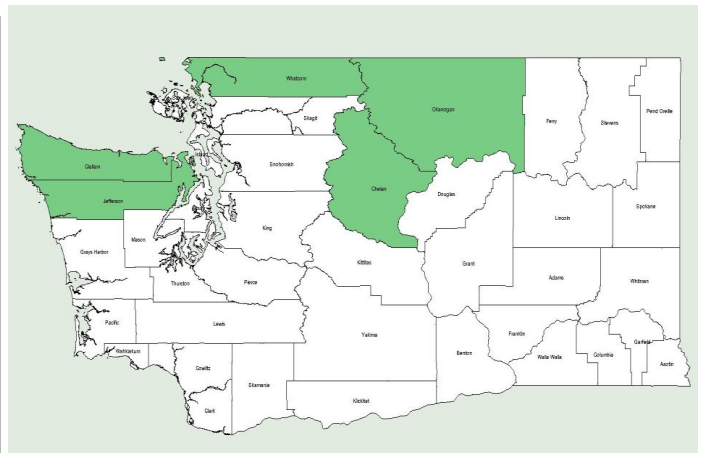
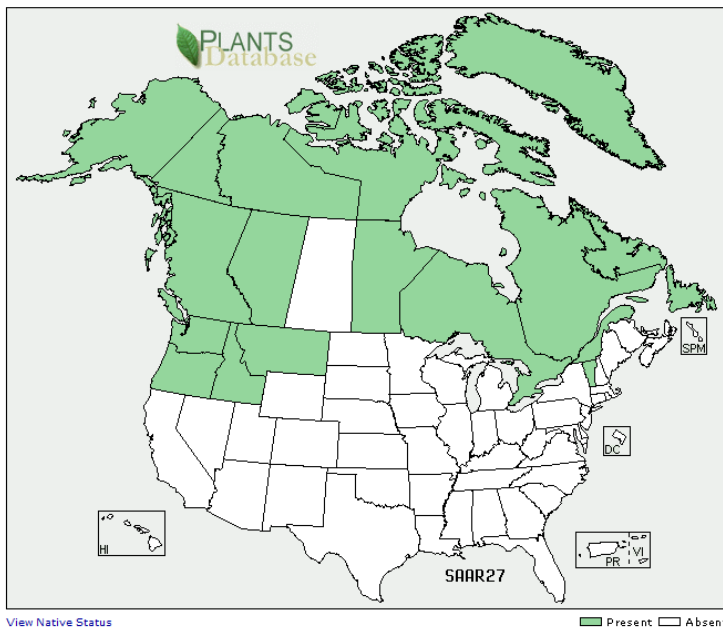
Margaret Williams. Courtesy of Nevada Native Plant Society. ©Nevada Native Plant Society

©Gary A. Monroe. United States, CA, Nevada Co. 1991

North American Distribution

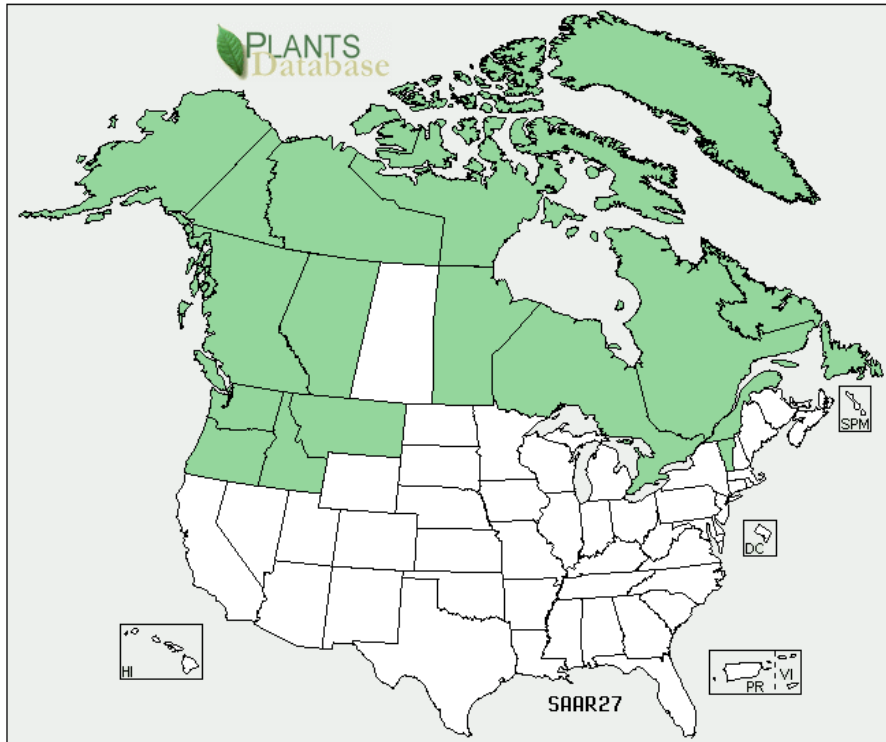
Source: USDA PLANTS Database

Washington State Distribution



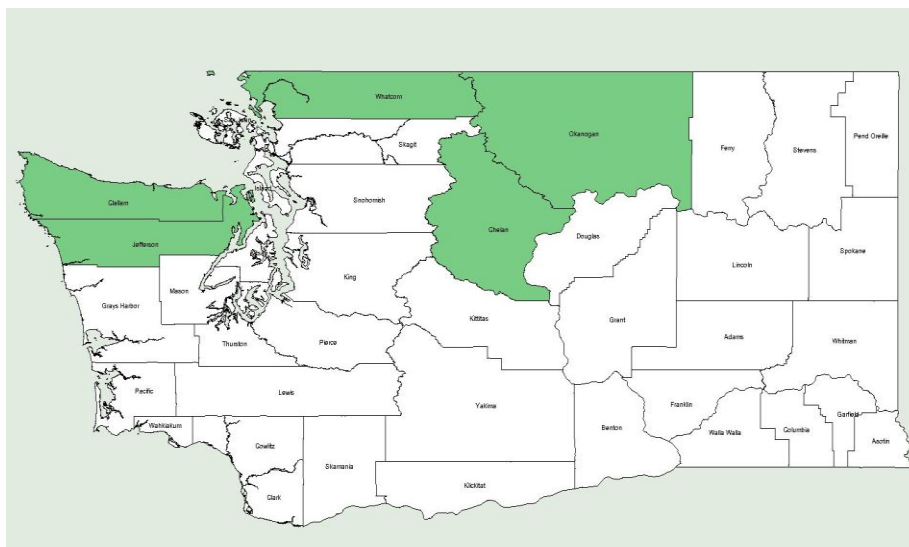
TAXONOMY

Family Names	
Family Scientific Name:	Salicaceae
Family Common Name:	Willow Family
Scientific Names	
Genus:	Salix
Species:	Arctica
Species Authority:	Pall.
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., <i>Elymus glaucus</i> Buckley), including variety or subspecies information) ⁷	<p><i>Salix anglorum</i> auct. non Cham. <i>Salix anglorum</i> Cham. var. <i>antiplasta</i> C.K. Schneid. <i>Salix anglorum</i> Cham. var. <i>araioclada</i> C.K. Schneid. <i>Salix anglorum</i> Cham. var. <i>kophophylla</i> C.K. Schneid. <i>Salix arctica</i> R. Br. ex Richardson, non Pall. <i>Salix arctica</i> Pall. ssp. <i>crassijulis</i> (Trautv.) Skvort. <i>Salix arctica</i> Pall. ssp. <i>tortulosa</i> (Trautv.) Hultén <i>Salix arctica</i> Pall. var. <i>antiplasta</i> (C.K. Schneid.) Fernald <i>Salix arctica</i> Pall. var. <i>araioclada</i> (C.K. Schneid.) Raup <i>Salix arctica</i> Pall. var. <i>brownei</i> Andersson <i>Salix arctica</i> Pall. var. <i>kophophylla</i> (C.K. Schneid.) Polunin <i>Salix arctica</i> Pall. var. <i>pallasii</i> (Andersson) Kurtz <i>Salix arctica</i> Pall. var. <i>tortulosa</i> (Trautv.) Raup <i>Salix brownei</i> (Andersson) Bebb <i>Salix crassijulis</i> Trautv. <i>Salix hudsonensis</i> C.K. Schneid. <i>Salix pallasii</i> Andersson <i>Salix pallasii</i> Andersson var. <i>crassijulis</i> (Trautv.) Andersson <i>Salix tortulosa</i> Trautv.</p>
Common Name(s):	Arctic willow
Species Code (as per USDA Plants database):	SAAR27
GENERAL INFORMATION	
Geographical range (distribution maps for North America and Washington state)	<p><i>S. arctica</i> is a circumboreal species, found in northern North America including Canada (Alta., B.C., Nfld. and Labr., N.W.T., Nunavut, Ont., Que., Yukon), United States (Alaska Washington, Idaho, Oregon, Vermont, Montana), Greenland, Eurasia (China, Chukotka, Novaya Zemlya, Russian Far East, arctic, e Siberia), and Atlantic Islands (Iceland) in alpine and subalpine zones^{10 1 7}</p>



[View Native Status](#)

Present Absent



Ecological distribution (ecosystems it occurs in, etc):

Alpine meadows, tundra & open slopes⁴; near & above timberline in mountains⁹. Arctic-alpine, wet to mesic or dry habitats, including hummocks in wet *Sphagnum* bogs and sedge meadows, polygonal tundra, solifluction slopes, snowbeds, margins of pools, beach ridges, shale and gypsum ridges, gneissic cliffs, colluvial slopes, talus slopes, glacial moraines, imperfectly drained calcareous silty till, muddy salt flats, frost-heaved clay polygons, dry calcareous gravel, coarse sandy soil.¹⁰

Climate and elevation range

alpine meadows, typically 2000+ elevation ¹

Local habitat and abundance; may include commonly associated species

alpine meadows of N. Cascades,

Associated with alpine grasses such as; altai fescue, mountain sagewort, bellard's kobresia, alpine sweetgrass, one-headed pussytoes, mountain harebell, glaucous gentian, spiked woodrush, diverse-leaved cinquefoil and small-awned sedge.

Associated with some dwarf shrubs such as; four-angled mountain-heather, dwarf

	<p>snow willow, polar willow, white mountain-heather, mountain-avens, bog blueberry, partridgefoot and lingonberry.</p> <p>Also associated with various mosses and lichens including; awned haircap moss, broom moss, common coral, as well as, Cetraria, Cladonia and Peltigera lichens.</p>
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	Stress-tolerator, climax species
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	Perennial dioecious dwarf shrub from seeds, usually formed in prostrate or trailing mats from a central stem not exceeding 15cm in height ¹⁰ , though sometimes able to reach up to 50 cm tall ⁴ usually due to richer soil which causes excessive growth ⁶ . Leaves: alternate, deciduous, grayish-green, with a whitish bloom and sparsely hairy beneath; broadly oval, 2-8cm long; tip blunt or pointed; stalks 4-12mm long ⁴ See illustrations above. ¹⁰
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	Alpine meadows, Logan Pass, 2032m elev. ¹
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method (Options: Seed or Vegetative):	<p>Vegetative: semi-soft tip cuttings, Semi-softwood stem tip cuttings are collected when leaf buds have just begun to break dormancy after snowmelt at high elevations¹, dependent on local climate, but estimated to be in May-June⁶</p> <p>Seed: It is possible to propagate from seed, but due to poor germination rates⁸ and the need to plant the seed within 24 hours of collection¹¹, cuttings are the more successful and preferred method. For more information on seed propagation see “other comments”</p>
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container (plug) ^{1 2}
Stock Type:	800 mL ^{1 2}

Time to Grow (from seeding until plants are ready to be outplanted):	1 year ¹
Target Specifications (size or characteristics of target plants to be produced):	Stock Type: Container cuttings Height: 3 cm in height Caliper: 4 mm Root System: firm plug in 800 ml containers ¹
Propagule Collection (how, when, etc):	Vegetative Propagation Method: Pre-Rooting Type of Cutting: Spring semi-softwood stem tip cuttings Semi-softwood stem tip cuttings are collected when leaf buds have just begun to break dormancy after snowmelt at high elevations ¹
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Cuttings are kept moist and under refrigeration prior to pretreatment ¹ ,
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Cuttings are 4 to 6 cm in length and 5 mm in caliper and are treated with 1000 ppm IBA powder. Cuttings are struck in mistbed with bottom heat for 2 to 4 weeks. <i>Salix arctica</i> is easily produced by cuttings. <i>Salix</i> has latent preformed root initials present in the stem and initial rooting is seen in cuttings in one week. Rooting %: 95% to 98% ¹
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	The outdoor mistbed has automatic intermittent mist that is applied at 6 second intervals every 6 minutes. Too frequent misting will result in leaf and stem rot. Misting frequency is increased or decreased according to daily outdoor temperature and wind. Bottom heat is maintained at 21C with heating cables 12 cm beneath rooting media. Rooting media is 50% perlite and 50% sand. Mistbed is covered with a shadecloth during rooting. Potting/Germination soil for this species should be well drained ³ , and general alpine plant germination soil is recommended as 2 parts loam, 2 parts peat, 1 part sand, and 2 parts grit, switching to 4 parts loam, 2 parts organic matter, and one part coarse sand for potting. After cuttings are potted, they are moved to an outdoor shadehouse for 4 weeks. They are later moved to full sun exposure in the outdoor nursery and are irrigated with Rainbird automatic irrigation system in early morning until containers are thoroughly leached. Average growing season of nursery is from late April after snowmelt until October 15th. ¹
Establishment Phase (from seeding to germination):	Time to Transplant: 4 to 6 weeks. Cuttings that were prerooted were lifted out of mistbed after adequate root systems were formed. Roots generate from the nodes below the surface of the rooting media. ¹
Length of Establishment Phase:	4 to 6 weeks ¹

Active Growth Phase (from germination until plants are no longer actively growing):	After cuttings were lifted from the mistbed, they were potted into 490 ml containers. Growing media used is 70% 6:1:1 milled sphagnum peat, perlite, and vermiculite 30% sand with Osmocote controlled release fertilizer (13N:13P2O5:13K2O; 8 to 9 month release rate at 21C) and Micromax fertilizer (12%S, 0.1%B, 0.5%Cu, 12%Fe, 2.5%Mn, 0.05%Mo, 1%Zn) at the rate of 2 grams of Osmocote and 1 gram of Micromax per container. Cuttings were irrigated after potting and placed in the shadehouse for 4 weeks. After establishment in the shadehouse, plants were moved to full sun exposure in the outdoor nursery. ¹
Length of Active Growth Phase:	8 weeks ¹
Hardening Phase (from end of active growth phase to end of growing season; primarily related to the development of cold-hardiness and preparation for winter):	Irrigation is gradually reduced in September and October. Plants were given one final irrigation prior to winterization. ¹
Length of Hardening Phase:	8 weeks ¹
Harvesting, Storage and Shipping (of seedlings):	Total Time to Harvest: 1 year Harvest Date: July Storage Conditions: Overwinter in outdoor nursery under insulating foam and snow. One final irrigation is applied prior to overwintering. ¹
Length of Storage (of seedlings, between nursery and outplanting):	5 months
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Outplanting Site: Alpine meadow, 2000+ elevation Outplanting Date: July and August after snowmelt. Outplanting Survival at 3 Years: 100% ¹
Other Comments (including collection restrictions or guidelines, if available):	Experimental propagation techniques were developed at Glacier National Park in Montana, USA by Jeff Evans ¹ and therefore may vary for different climates or subspecies, though <i>S. arctica</i> is noted for being easily propagated in various climates ⁶ SEED PROPAGATION: %Germination: unknown Seed Processing: Seed is collected when capsules open in late August and early September. Seed is light tan at maturity. Unlike other species of <i>Salix</i> , seed of <i>S. arctica</i> can be stored for longer than one year at 0C. Exact longevity is unknown. Seed dormancy is classified as physiological dormancy. ¹ Seeds are placed in cold moist stratification for 30 days to break down dormancy ¹¹ . Germination occurs at 25C ²

INFORMATION SOURCES

References (full citations):	<p>(1)Evans, Jeff 2001. <i>Propagation protocol for vegetative production of container Salix arctica Pall. plants (800 ml containers)</i>; USDI NPS - Glacier National Park, West Glacier, Montana. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 15 April 2012). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.</p> <p>(2)Baskin, Carol C.; Baskin, Jerry M. 2002. <i>Propagation protocol for production of container Salix arctica Pall. plants</i>; University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 15 April 2012). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.</p> <p>(3)Murfitt, Rex. <i>Creating And Planting Alpine Gardens</i>. Wayne, PA: B.B. Mackey Books, 2005.</p> <p>(4)Pojar J., McKinnon A., <i>Plants of the Pacific Northwest: Washington, Oregon, British Columbia and Alaska, B.C.</i> Canada: Ministry of Forests and Lone Pine Publishing, 2004.</p> <p>(5)Wilford, Richard. <i>Alpines: From Mountain To Garden</i>. Richmond, Surrey, UK: Royal Botanic Gardens, Kew, 2010</p> <p>(6)Hills, Lawrence D. <i>The propagation of alpines</i>; London: Faber and Faber, 1959.</p> <p>(7) USDA Plants Database. <i>Salix Arctica Pall</i>: http://plants.usda.gov/java/profile?symbol=SAAR27</p> <p>(8) Deno, Norman C.. <i>Seed Germination, Theory And Practice</i>. State College, PA: The Author, 1993</p> <p>(9) University of Texas at Austin Native Plant Database. <i>Salix Arctica Pall</i>. URL: http://www.wildflower.org/plants/result.php?id_plant=SAAR27 © 2012 Lady Bird Johnson Wildflower Center</p> <p>(10) eFloras (2008). <i>Salix Arctica</i>. URL:http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200005753 (April 15, 2012) Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA</p> <p>(11) Young, James A, and Cheryl G. Young. <i>Collecting, Processing, and Germinating Seeds of Wildland Plants</i>. Portland, Or: Timber Press, 1986. Print.</p>
Other Sources Consulted (but that contained no pertinent information) (full citations):	<p>McGary, Jane. <i>Rock Garden Plants Of North America: An Anthology From The Bulletin Of The North American Rock Garden Society</i>. Portland: Timber Press, 1996. SB 421 .R62 1996</p> <p>Grey-Wilson, C. <i>A Manual Of Alpine And Rock Garden Plants</i>. Portland: Timber Press, 1989.</p> <p>Innes, Clive. <i>Alpines: The Illustrated Dictionary</i>. Portland, OR: Timber Press, 1995</p>
Protocol Author (First and last name):	Jamie Bass
Date Protocol Created or Updated (MM/DD/YY):	April 18, 2012

Note: This template was modified by J.D. Bakker from that available at: <http://www.nativeplantnetwork.org/network/SampleBlankForm.asp>

Attached are two *S. arctica* propagation protocols from which this protocol was updated.

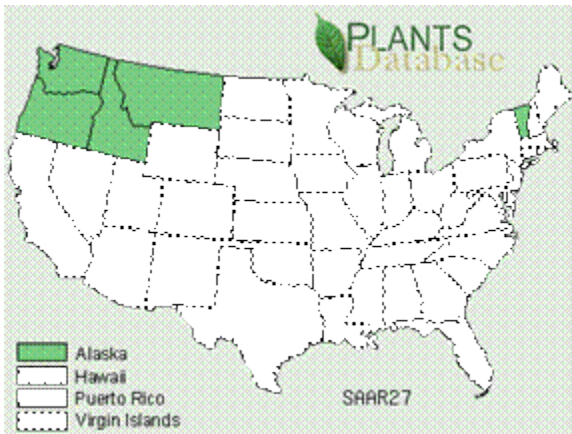
Plant Data Sheet

Species (common name, Latin name)

Arctic Willow, *Salix arctica*



.....Various plant forms of *Salix arctica* (4).....



Range

S. arctica is a circumpolar species found from Alaska south to Montana, Idaho, and Oregon and east to Newfoundland. (2)

Climate, elevation

Alpine meadows, 2000m+ elevation.

Local occurrence (where, how common)

Common in the alpine meadows of the N. Cascades.

.....*Salix arctica* range (2).....

Habitat preferences

Alpine meadows

Plant strategy type/successional stage (stress-tolerator, competitor,

Stress-tolerator, climax species

Associated species (PNW)

Associated with alpine grasses such as; altai fescue, mountain sagewort, bellard's kobresia, alpine sweetgrass, one-headed pussytoes, mountain harebell, glaucous gentian, spiked woodrush, diverse-leaved cinquefoil and small-awned sedge.

Associated with some dwarf shrubs such as; four-angled mountain-heather, dwarf snow willow, polar willow, white mountain-heather, mountain-avens, bog blueberry, partridgefoot and lingonberry.

Also associated with various mosses and lichens including; awned haircap moss, broom moss, common coral, as well as, Cetraria, Cladonia and Peltigera lichens.

May be collected as: (seed, layered, divisions, etc.)

Seed, Spring semi-softwood stem tip cuttings (1,2)

Collection restrictions or guidelines

Seed is collected when capsules open in late August and early September. Seed is light tan at maturity. (2)

Semi-softwood stem tip cuttings are collected when leaf buds have just begun to break dormancy after snowmelt at high elevations. (2)

Seed germination (needs dormancy breaking?)

Physiological dormancy, need a 5 month cold-moist stratification. (3)

Seed life (can be stored, short shelf-life, long shelf-life)

Seed can be stored for longer than one year at 0°C (2)

Recommended seed storage conditions

Seeds store at 0°C. (3)

Cuttings should be kept moist and under refrigeration (2)

Propagation recommendations (plant seeds, vegetative parts, cuttings, etc.)

Seeds can be surface sown in flats after collection in the fall and given a 5 month cold-moist stratification. (3)

Cuttings should be 4 to 6 cm in length and 5 mm in caliper and be treated with 1000 ppm IBA powder. (1,2)

Soil or medium requirements (inoculum necessary?)

Well drained sandy soils.

Installation form (form, potential for successful outcomes, cost)

Cuttings recommended, very cheap but require treatment with IBA, see protocol. (2)

Recommended planting density

36-48 in. (1)

Care requirements after installed (water weekly, water once etc.)

Average Water Needs; Water regularly; do not overwater

Requires consistently moist soil; do not let dry out between waterings (1)

Normal rate of growth or spread; lifespan

Grows as a shrub that rarely exceeds more than 60 centimeters in height and forms dense mats.

Sources cited

1. http://plants.usda.gov/cgi_bin/topics.cgi?earl=plant_profile.cgi&symbol=SAAR27

2. Baskin, Carol C.; Baskin, Jerry M. 2002. Propagation protocol for production of container *Salix arctica* Pall. plants; University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: <http://www.nativeplantnetwork.org> (accessed 26 April 2005). Moscow (ID): University of Idaho, College of

Natural Resources, Forest Research Nursery.

http://www.nativeplantnetwork.org/network/view.asp?protocol_id=169,1450.

3. Evans, Jeff. 2001. Propagation protocol for vegetative production of container *Salix arctica* Pall. plants (800 ml containers); Glacier National Park, West Glacier, Montana. In: Native Plant Network. URL: <http://www.nativeplantnetwork.org> (accessed 26 April 2005). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

4. http://elib.cs.berkeley.edu/cgi/img_query?text_only=0&display1=image+ID+num&where-calrecnum=7261.

5. Standards for broad terrestrial ecosystem classification and mapping for British Columbia found at http://srmwww.gov.bc.ca/risc/pubs/teecolo/bei/bei_1998.htm#p4_0.

Data compiled by (student name and date)

Nick Ostrovsky 4/26/05

Protocol Information

Native Plant Nursery
USDI NPS - Glacier National Park
West Glacier, Montana 59936
(406) 888-7835

**Glacier
National Park**
Montana



Family Scientific Name: **Salicaceae**

Family Common Name: **Willow Family**

Scientific Name: ***Salix arctica* Pall.**

Common Name: **Arctic willow**

Species Code: **SALART**

Ecotype: **Alpine meadows, Logan Pass, 2032m elev.,**

General Distribution: ***S. arctica* is a circumboreal species, occurring south in North America through the Cascades and Rocky Mountains to California and New Mexico in alpine and subalpine zones.**

Propagation Goal: **Plants**

Propagation Method: **Vegetative**

Product Type: **Container (plug)**

Stock Type: **800 ml containers**

Time To Grow: **1 Years**

Target Specifications: **Stock Type: Container cuttings**

Height: 3 cm in height

Caliper: 4 mm

Root System: firm plug in 800 ml containers.

Propagule Collection: **Vegetative Propagation Method: Pre-Rooting**

Type of Cutting: Spring semi-softwood stem tip cuttings

Semi-softwood stem tip cuttings are collected when leaf buds have just begun to break dormancy after snowmelt at high elevations.

Propagule Processing: **Cuttings are kept moist and under refrigeration prior to pretreatment.**

Pre-Planting Treatments: **Cuttings are 4 to 6 cm in length and 5 mm in caliper and are treated with 1000 ppm IBA powder. Cuttings are struck in mistbed with bottom heat for 2 to 4 weeks. *Salix arctica* is easily produced by cuttings. *Salix* has latent preformed root initials present in the stem and initial rooting is seen in cuttings in one week.**

Rooting %: 95% to 98%

Growing Area Preparation/

Annual Practices for Perennial Crops: **The outdoor mistbed has automatic intermittent mist that is applied at 6 second intervals every 6 minutes. Too frequent misting will result in leaf and stem rot. Misting frequency is increased or decreased according to daily outdoor temperature and wind.**

Bottom heat is maintained at 21C with heating cables 12 cm beneath rooting media.

Rooting media is 50% perlite and 50% sand.

Mistbed is covered with a shadecloth during rooting.

After cuttings are potted, they are moved to an outdoor shadehouse for 4 weeks. They are later moved to full sun exposure in the outdoor nursery and are irrigated with Rainbird automatic irrigation system in early morning until containers are thoroughly leached.

Average growing season of nursery is from late April after snowmelt until October 15th.

Establishment Phase: **Time to Transplant: 4 to 6 weeks.**

Cuttings that were prerooted were lifted out of mistbed after adequate root systems were formed. Roots generate from the nodes below the surface of the rooting media.

Length of Establishment Phase: **4 to 6 weeks**

Active Growth Phase: **After cuttings were lifted from the mistbed, they were potted into 490 ml containers. Growing media used is 70% 6:1:1 milled sphagnum peat, perlite, and vermiculite 30% sand with Osmocote controlled release fertilizer (13N:13P2O5:13K2O; 8 to 9 month release rate at 21C) and Micromax fertilizer (12%S, 0.1%B, 0.5%Cu, 12%Fe, 2.5%Mn, 0.05%Mo, 1%Zn) at the rate of 2 grams of Osmocote and 1 gram of Micromax per container. Cuttings were irrigated after potting and placed in the shadehouse for 4 weeks. After establishment in the shadehouse, plants were moved to full sun exposure in the outdoor nursery.**

Length of Active Growth Phase: **8 weeks**

Hardening Phase: **Irrigation is gradually reduced in September and October. Plants were given one final irrigation prior to winterization.**

Length of Hardening Phase: **8 weeks**

Harvesting, Storage and Shipping: **Total Time to Harvest: 1 year**

Harvest Date: July

Storage Conditions: Overwinter in outdoor nursery under insulating foam and snow. One final irrigation is applied prior to overwintering.

Length of Storage: **5 months**

Outplanting performance on typical sites: **Outplanting Site: Logan Pass, Glacier National Park, MT.**

Outplanting Date: July and August after snowmelt.

Outplanting Survival at 3 Years: 100%

Other Comments: **SEED PROPAGATION:**

Seeds/Kg: 22,000,000/ kg approx.

%Germination: unknown

Seed Processing: Seed is collected when capsules open in late

August and early September. Seed is light tan at maturity. Unlike other species of *Salix*, seed of *S. arctica* can be stored for longer than one year at 0C. Exact longevity is unknown.

Seed dormancy is classified as physiological dormancy.

Seed Treatments: Seeds are surface sown after collection in the fall and given a 5 month cold-moist stratification.

Sowing/Planting Technique: Seeds are surface sown in flats.

Establishment Phase: Germination occurs in late spring under fluctuating temperatures.

Germination occurred over a 1 month period. Seedlings were transplanted to pots at the true leaf stage.

References: Flora of the Pacific Northwest, Hitchcock and Cronquist, University of Washington Press, 7th printing, 1973. Seeds of the Woody Plants in North America, Young and Young, Dioscorides Press, 1992.

Seed Germination Theory and Practice, 2nd Edition, N. Deno, published June 1993.

Glacier Park Native Plant Nursery Propagation Records, unpublished.

1999 Revegetation Monitoring Report, Glacier National Park, Asebrook, J. and Brenneman, B., unpublished.

Citation:

Evans, Jeff 2001. Propagation protocol for vegetative production of container *Salix arctica* Pall. plants (800 ml containers); USDI NPS - Glacier National Park, West Glacier, Montana. In: Native Plant Network. URL: <http://www.nativeplantnetwork.org> (accessed 18 April 2012). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.