

Plant Propagation Protocol for *Salix candida*

ESRM 412 – Native Plant Production

URL: <https://courses.washington.edu/esrm412/protocols/2026/SACA4.pdf>



Figure 1: *Salix candida* taken on June 13, 2007, by Joe Arnett in Stevens County, Washington¹⁴

TAXONOMY	
Plant Family	
Scientific Name	Salicaceae ¹
Common Name	Willow family ¹
Species Scientific Name	
Scientific Name	<i>Salix candida</i> Flueggé ex Willd. ¹
Varieties	<i>Salix candida</i> Flueggé ex Willd., var. <i>denudata</i> Andersson ¹ <i>Salix candida</i> Flueggé ex Willd. var. <i>tomentosa</i> Andersson ¹
Sub-species	Not found
Cultivar	The cultivar “Silver Fox” is a compact, dwarf variety with soft, felted, bright silvery foliage, striking yellow winter buds and stems, and a mature size of about 3 feet tall and wide. ¹³
Common Synonym(s)	<i>Salix candidula</i> Nieuwl ¹
Common Name(s)	sage willow ⁸ , sageleaf willow ⁸ , sage-leaved willow ¹⁰ , hoary willow ^{8,9,10}
Species Code (as per USDA Plants database)	SACA4
GENERAL INFORMATION	

Geographical range

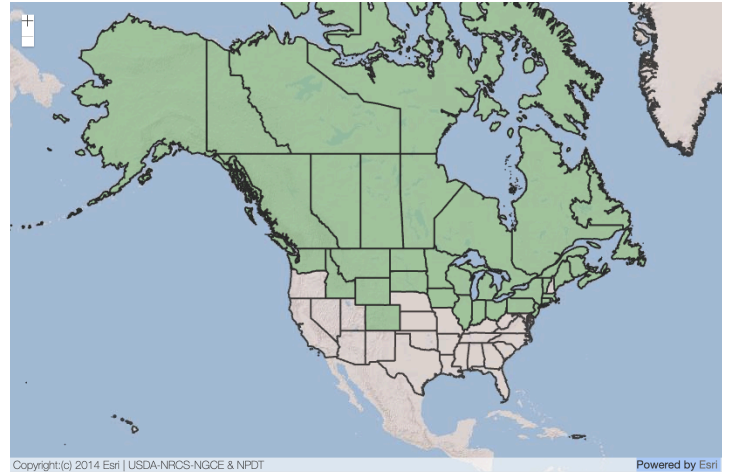


Figure 2: Distribution in North America¹

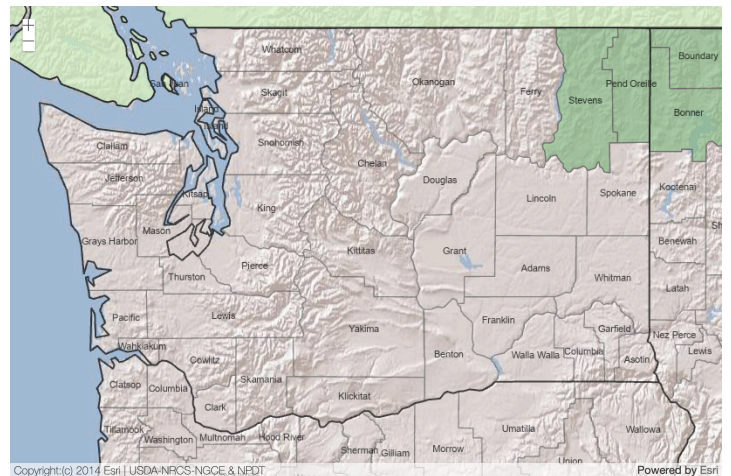


Figure 3: Distribution in N.E. Washington¹

Northern tier of the U.S., including Alaska, and in Canada from Newfoundland to British Columbia.⁶ See maps above for distribution in North America and Washington State.¹

Ecological distribution

Native habitat includes cold, open fens, swamps, (calcareous) bogs, and thickets.^{8,9}

Climate and elevation range

Light requirements are sun or partial shade.⁸

Elevation in Washington is 610-900 m (2000-2950 ft).¹¹

Local habitat and abundance

Associated species include thinleaf alder (*Alnus incana* ssp. *tenuifolia*), Cascara buckthorn (*Frangula purshiana*), willows (*Salix* spp.), bog birch (*Betula glandulosa*), red-osier dogwood (*Cornus sericea*), and sedges (*Carex utricularia*, *C. lasiocarpa*, *C. rostrata*, and others).¹¹

Plant strategy type / successional stage	Stress-tolerant (growing in waterlogged soils and low temperatures), K-selected species (long-lived perennial species that devote several years to vegetative growth before reproducing). ⁶
Plant characteristics	Classified as a perennial shrub. ^{1,8,10} Literature varies on the height of the plant, but ranged from 1.5 to 8 ft tall. The young twigs are densely covered with white hairs, while older twigs turn yellow to light brown. The leaves are narrow and rigid, dark green and slightly tomentose on the upper surface, and densely white-haired underneath. ⁸ Male and female catkins occur on separate plants (dioecious). Male catkins are 1.5–2.5 cm long and up to 1 cm wide, with two stamens bearing purple anthers and hairless, free filaments. Mature female catkins are 3–5 cm long, with reddish styles and stigmas; styles are 0.8–1.7 mm long, and the tiny, two-lobed stigmas are 0.2–0.5 mm. ¹¹ Flowering occurs in May to June as the leaves emerge. ^{7,11} The pointed capsules are 5–7.5 mm long and covered in white woolly hairs. Seeds are numerous, minute, and equipped with tufts of cottony hairs. ¹¹ Susceptible to insects, disease, and wind damage. ⁸

PROPAGATION DETAILS: FROM SEED

Disclaimer: Protocol generalized to all species in the *Salix* genus since no propagation information specifically for *Salix candida* was found. The propagation protocol for *Salix bebbiana*, *Salix exigua*, and *Salix scouleriana* produced in one-gallon tree pots by Dave Dressen in 2003 was very similar. For simplicity purposes, the protocol for *Salix exigua* was cited in the references. Information in this section is from ² unless mentioned otherwise.

Ecotype	Not found
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	
Time to Grow	Not found
Target Specifications	Well-developed, cohesive root mass that holds together and prevents the root ball from falling apart during outplanting.
Propagule Collection Instructions	Frequent monitoring of catkin development is essential for collecting viable <i>Salix</i> seeds. Therefore, maintaining stock plants in a nursery could be

	<p>considered for ease of visitation. One source says to collect the seed heads as soon as they are ripe and fluffy,⁴ but others say harvest should be timed to coincide with the first appearance of cotton emerging from partially opened capsules.² That waiting until capsules are nearly fully open may seem ideal, but spring winds can quickly disperse seeds at this stage, resulting in lost seed. Female catkins are placed in paper bags to capture seeds as the capsules open during drying. Under dry, room-temperature conditions, seed release usually occurs within a few days. When catkins are spread in a thin layer (one to two catkins deep), seeds disperse readily with minimal attention. However, thicker layers require regular turning and mixing to ensure even drying and effective seed release. While plastic bags may be used briefly, catkins should be transferred to paper bags or drying racks as soon as possible to prevent moisture buildup and decay.</p>
<p>Propagule Processing/Propagule Characteristics</p>	<p>A compressed air source and a series of soil screens—arranged from top to bottom at 250 μm, 500 μm, and 125 μm—can be used. Dry catkins with partially opened capsules are placed between the 250 μm and 500 μm screens. A swirling jet of compressed air is then directed through the top screen, dislodging the seeds. The seeds pass through and collect on the 125 μm screen, while the cotton and empty catkins remain on the 500 μm screen.² For temporary storage of collected material, store in air-porous bags, in cool and dry conditions.¹⁵</p>
<p>Pre-Planting Propagule Treatments</p>	<p>Stratification is not required. Surface-sow cleaned seeds immediately.^{2,4,5}</p>
<p>Growing Area Preparation / Annual Practices for Perennial Crops</p>	<p>Greenhouse conditions are maintained at 70°F (21°C) during the day and 55°F (13°C) at night in winter, with summer temperatures kept below a maximum of 85°F (29°C) using evaporative cooling. For mini-plug irrigation, plug trays are placed on a watering bench equipped with mini-sprinklers that automatically irrigate once each morning. Information on how long or how much moisture is not indicated. The bench is lined with a copper-coated fabric (Texel Tex-Rr Forestry fabric) to limit root growth out of the plug cells. Beneath this is a filter fabric (Dewitt soil separator</p>

	<p>fabric), which helps draw excess moisture out of the cells through capillary action.</p> <p>Ray Leach Super Cells (10 in³ or 164 ml volume, 1.5 in. diameter, 8.25 in. depth) are used. The growing medium is a mix of two parts Sunshine #1 or #2 and one part perlite, amended with controlled-release fertilizer (CRF) Osmocote Plus 15-9-12. A 3–4 month release formulation is used for summer-grown plants, while a 5–6 month release is used for those started in spring.</p>
Establishment Phase Details	<p>Sowing seeds by hand can be challenging due to their very small size (approximately 1 mm long and 0.3–0.5 mm wide). Mix seeds with a similarly sized material, such as grit or perlite,² and cover the seed with 1/8 in (3 mm) of fine grit.⁴</p> <p>While the seeds are typically clean enough for mechanical sowing, automated seeders would only be practical for large-scale operations.</p> <p>The surface of the growing medium must remain consistently moist.^{2,4,5} Germination often occurs within one to two days,⁴ indicated by swelling and separation of the cotyledons.² Seedlings should be thinned as needed, either during transplanting from mini-plugs or afterward, once they are large enough to clip.</p> <p>In the establishment phase, seedlings are fertigated every other watering with a soluble fertilizer (Peters Peat Lite Special 20-10-20) at 200 mg/L nitrogen. Thinning to one seedling per container typically occurs when plants reach 2–4 cm in height.</p>
Length of Establishment Phase	1-2 days
Active Growth Phase	<p>Plants are transferred into one-gallon tree pots measuring 4 × 4 × 14 inches (10 × 10 × 36 cm), with a volume of 173 in³ (2.83 L). A commercial nursery mix composed of aged, screened softwood bark, pumice, and sphagnum peat moss is used. Transplanting into tree pots typically takes place in late summer of the first year or late spring of the second year. Pots are filled with media and dibbled to accommodate Super Cell plugs. Controlled-release fertilizer (CRF) is applied as a top dressing at or shortly after planting.</p>
Length of Active Growth Phase	Not found

Hardening Phase	Watering is gradually reduced from late September through early October to encourage hardening off. Before winter, tree pot cages are encircled with straw bales to buffer temperature fluctuations and insulate the root systems.
Length of Hardening Phase	Not found
Harvesting, Storage, and Shipping	Not found
Length of Storage	Not found
Guidelines for Outplanting / Performance on Typical Sites	Not found
Other Comments	Not found
PROPAGATION DETAILS: VEGETATIVE	
Disclaimer: Protocol generalized to all species in the <i>Salix</i> genus. Information in this section is from ³ unless mentioned otherwise.	
Ecotype	Not found
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	1,2,3,4-gallon containers
Time to Grow	1 year
Target Specifications	Seedlings reached their target stage when their roots filled the container without becoming root-bound.
Propagule Collection Instructions	Seedlings can be propagated from cuttings taken from stooling beds or wild plants. These cuttings are collected in late fall or early winter after leaf drop, but before buds begin to swell in spring (Steinfeld, Robson). Only current-year growth is used, typically from stems about 3/8 to 5/8 inch in diameter. Stems should have healthy, intact vegetative buds, while any with damaged buds, disease, or insect damage are avoided. The cuttings are sealed in plastic and stored just below freezing (28–30°F). To maintain genetic diversity, material is collected from an equal number of male and female plants, representing as many individuals as possible according to genetic guidelines.
Propagule Processing/Propagule Characteristics	Not found
Pre-Planting Propagule Treatments	Before planting, stems are cut into 4–6 inch sections, each containing at least two buds. The cut is made so that a terminal bud is positioned within about 1/2 inch of the top of the cutting.

<p>Growing Area Preparation / Annual Practices for Perennial Crops</p>	<p>Treepots™ from Stuewe & Sons, Inc. are used as containers, typically in sizes ranging from 1 to 4 gallons. They are filled with Grower’s Gold Mix #1 (SunGro Horticulture), a medium composed of 40% fine composted pine/fir bark (fine 3/8” minus), 35% Canadian sphagnum peat moss (growers grade), and 25% screened volcanic pumice (3/8” minus). The media is pre-moistened and includes a starter fertilizer (6-10-6 with trace elements). Containers are filled and lightly tamped to reduce large air spaces, leaving about 1 inch of space at the top. Containers are reused but are pressure-washed at 160°F between crops to remove old media and ensure cleanliness. Most seedlings are grown outdoors on gravel pads without shade. These pads are graded to allow proper drainage and prevent water from pooling. The nursery climate is hot and dry in summer, with average highs around 87.5°F in July and August. Spring temperatures are moderate, with frost in the upper 20s being uncommon. Fall remains relatively warm, with October highs averaging 67°F and lows around 37.5°F, and frost in the low 20s is rare.</p>
<p>Establishment Phase Details</p>	<p>Cuttings are inserted into the growing medium so that only the terminal bud remains just above the surface. Containers are then placed on portable steel racks measuring 6.5 by 3.5 feet.³ Rooting hormones can be used on the cut stems, but are not necessary.⁵ A few weeks after transplanting, a top dressing of isobutylidene diurea fertilizer is applied. Wil-Gro (18-6-12 with Mg, S, and Fe) is used at a rate of 1/16 cup for one-gallon containers and 1/8 cup for two-, three-, and four-gallon containers. Seedlings are fertilized once per year, with an additional application in the spring if they are held over for a second year. During the establishment phase, seedlings are irrigated one to two times per week using an overhead fixed irrigation system. Rainbird BR5 sprinkler nozzles are mounted on risers 5–7 feet tall to accommodate plant height. The risers are arranged in a grid pattern with a spacing of approximately 20 by 30 feet.</p>
<p>Length of Establishment Phase</p>	<p>1 month</p>
<p>Active Growth Phase</p>	<p>Seedlings are irrigated in the early morning when the wind is minimal. Watering is scheduled based on the</p>

	moisture level of the plug, which is typically maintained near field capacity and not allowed to dry out significantly. During summer, when temperatures reach the high 80s, seedlings are watered every 2–3 days for up to 4.5 hours per session. Overhead irrigation is not used for afternoon cooling. Seedlings are routinely monitored for pests, although insects and diseases are uncommon for this species and stock type. Hand weeding is required about every six weeks.
Length of Active Growth Phase	3 months
Hardening Phase	Hardening begins in late summer by reducing the frequency of irrigation. Seedlings are generally tolerant of typical fall and winter nighttime temperatures. However, during extreme cold events with temperatures dropping into the low teens, seedlings are moved into unheated greenhouses or storage facilities until conditions improve. Due to the container design, roots tend to circle and accumulate at the bottom. To address this, and at the client’s request, the bottom inch of the root plug is pruned during the hardening phase by removing the plug and trimming it with an industrial paper cutter. For seedlings kept in containers for two years, clients may instead cut off the bottom inch of the container using a chop saw, leaving it open. This prevents root spiraling in the second year but makes the container unusable after removal.
Length of Hardening Phase	3 months
Harvesting, Storage, and Shipping	Seedlings are shipped in their containers without being removed or stored beforehand. The containers are placed upright in cardboard boxes and transported in either refrigerated or non-refrigerated enclosed trucks. In many cases, orders are shipped directly on the portable steel racks. Empty containers are returned during the summer after planting.
Length of Storage	Not found
Guidelines for Outplanting / Performance on Typical Sites	Rooted suckers can be transported, and branches can be used as live stakes in moist to wet soils. ⁵
Other Comments	Not found
INFORMATION SOURCES	
References	¹ USDA Natural Resources Conservation Service. (n.d.). [PLANTS Database]. United States Department of

Agriculture. *Salix Candida* Flueggé Ex Willd. Sageleaf Willow. Retrieved April 16, 2026, from <https://plants.sc.egov.usda.gov/plant-profile/SACA4>

²Dreesen, Dave. 2003. Propagation protocol for production of Container (plug) *Salix exigua* Nutt. plants One Gallon Tree Pot, 4"x4"x14"; USDA NRCS - Los Lunas Plant Materials Center Los Lunas, New Mexico. In: Native Plant Network. URL: <https://NativePlantNetwork.org> (accessed 2026/05/28). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources.

³Steinfeld, David. 2003. Propagation protocol for production of Container (plug) *Salix* plants 1,2,3 and 4-gallon containers; USDA FS - J Herbert Stone Nursery, Central Point, Oregon. In: Native Plant Network. URL: <https://NativePlantNetwork.org> (accessed 2026/04/16). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources.

⁴DK. (2025). *Propagating Plants: How to create new plants for free* (A. Toogod, Ed.). DK Publishing (Dorling Kindersley). (Original work published 2019, DK Publishing (Dorling Kindersley))

⁵Robson, K. A., Richter, A., & Filbert, M. (2008). *Encyclopedia of Northwest Native Plants for Gardens and Landscapes*. Timber pr.

⁶Decker, K. (2006, September 18). *Salix candida* Flueggé ex Wild. (sageleaf willow): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/salixcandida.pdf> [4/16/2026].

⁷Chicago Botanic Garden. (n.d.). *Salix Candida*. Retrieved April 17, 2026, from <https://www.chicagobotanic.org/plant-information/plant-finder/salix-candida-sage-willow>

⁸Lady Bird Johnson Wildflower Center. (n.d.). [Plant Database]. The University of Texas at Austin. *Salix Candida*. Retrieved April 17, 2026, from https://www.wildflower.org/plants/result.php?id_plant=SACA4

	<p>⁹Maine Department of Agriculture, Conservation & Forestry. (n.d.). Maine Natural Areas Program. <i>Salix Candida</i> Fluegge Ex Willd. Retrieved April 17, 2026, from https://www.maine.gov/dacf/mnap/features/salixcan.htm</p> <p>¹⁰Minnesota Wildflowers. (n.d.). Environment and Natural Resources Trust Fund. <i>Salix Candida</i> (Sage-Leaved Willow). Retrieved April 17, 2026, from https://www.minnesotawildflowers.info/shrub/sage-leaved-willow</p> <p>¹¹Montana Field Guide. (n.d.). Hoary Willow - <i>Salix Candida</i>. Retrieved April 16, 2026, from https://fieldguide.mt.gov/wa/?species=salix%20candida</p> <p>¹²Montana Natural Heritage Program. (n.d.). Hoary Willow - <i>Salix Candida</i>. Montana Field Guide. Retrieved April 17, 2026, from https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDSAL020K0</p> <p>¹³Woody Plants Database. (n.d.). Cornell University. Species: <i>Salix Candida</i>. Retrieved April 16, 2026, from https://woodyplants.cals.cornell.edu/plant/438</p> <p>¹⁴Arnett, J. (2007, June 13). Burke Museum Herbarium. Wtu044668 (<i>Salix Candida</i>). https://www.burkeherbarium.org/imagecollection/photo.php?Photo=wtu044668&Taxon=Salix%20candida&SourcePage=taxon</p> <p>¹⁵Wilkinson, K. M., Landis, T. D., Haase, D. L., Daley, B. F., & Dumroese, R. K. (Eds.). (2014). Tropical nursery manual: A guide to starting and operating a nursery for native and traditional plants (Agriculture Handbook 732). U.S. Department of Agriculture, Forest Service.</p>
Other Sources Consulted	<p>American Society of Naturalists. (1867). The American naturalist. Published for the American Society of Naturalists by the University of Chicago Press [etc.]. https://www.biodiversitylibrary.org/bibliography/62169</p> <p>Baskin, Jerry M.; Baskin, Carol C 2002. Propagation protocol for the production of Container (plug)</p>

	<i>Salix brachycarpa</i> Nutt. plants. University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: https://NativePlantNetwork.org (accessed 2026/04/16). US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources.
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