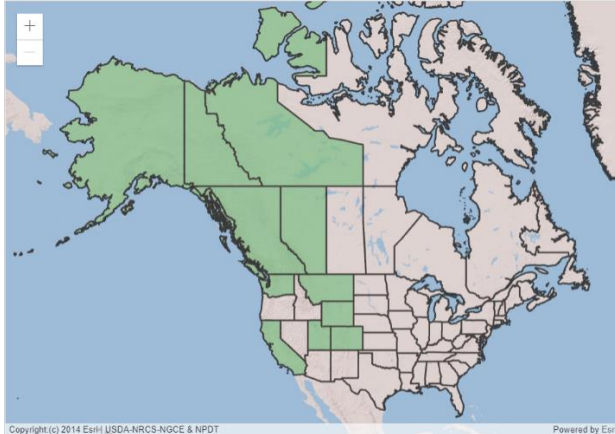


**Plant Propagation Protocol for *Artemisia arctica***  
**Boreal sagebrush**

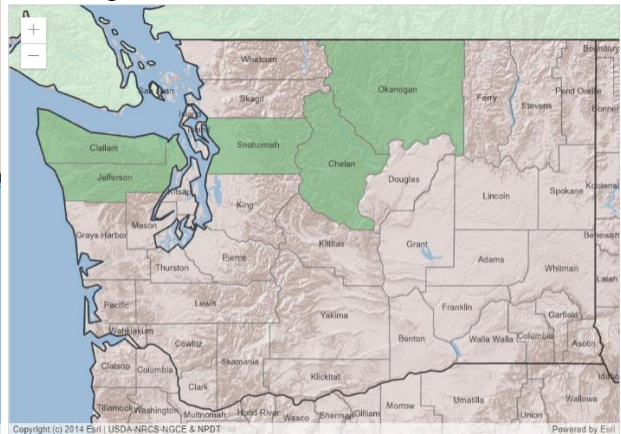
ESRM 412 – Native Plant Production  
 Spring 2022

URL: <http://courses.washington.edu/esrm412/protocols/2022/ARTARC.pdf>

North American Distribution:



Washington Distribution:



Source: USDA PLANTS database provided to them by Esri

**TAXONOMY**

<b>Plant Family</b>	
Scientific Name	<i>Asteraceae/Compositae</i>
Common Name	Aster family
<b>Species Scientific Name</b>	
Scientific Name	ARAR9 - <i>Artemisia arctica</i> Less.  Genus: <i>Artemisia</i> L. (sagebrush) Species: <i>Artemisia arctica</i> Less. (boreal sagebrush) Species authority: Less. Ssp
Varieties	
Sub-species	ARARA2- <i>Artemisia arctica</i> Less. subsp. <i>arctica</i> ARARB- <i>Artemisia arctica</i> Less. subsp. <i>beringensis</i> (Hultén) Hultén ARARC- <i>Artemisia arctica</i> Less. subsp. <i>comata</i> (Rydb.) Hultén
Cultivar	
Common Synonym(s)	ARAR9- <i>Artemisia norvegica</i> Fries ARAR2- <i>Artemisia norvegica</i> Fries var. <i>piceetorum</i> Welsh & Goodrich <i>Artemisia arctica</i> Less. subsp. <i>saxicola</i> (Rydb.) Hultén <i>Artemisia norvegica</i> Fries subsp. <i>saxatilis</i> (Bess.) Hall & Clements <i>Artemisia norvegica</i> Fries var. <i>saxatilis</i> (Bess.) Jepson <i>Artemisia norvegica</i> var. <i>pacifica</i> Gray, <i>Artemisia arctica</i> subsp. <i>ehrendorferi</i> Korobkov

	<p>ARARB- <i>Artemisia norvegica</i> Less var. <i>beringensis</i> Hultén</p> <p>ARARC- <i>Artemisia comata</i> Rydb. <i>Artemisia norvegica</i> Fries subsp. <i>comata</i> (Rydb.) Welsh <i>Artemisia norvegica</i> Fries var. <i>comata</i> (Rydb.) Welsh</p>
Common Name(s)	Boreal sagebrush, arctic wormwood, boreal sagewort, spruce wormwood
Species Code	<p>ARAR9</p> <p>NRCS Plant Codes; <b>ARAR9</b>, ARAR2, ARARB, ARARC FEIS abbreviations; <b>ARTARC</b>, ARTARCA, ARTARCB, ARTARCC</p>
<b>GENERAL INFORMATION</b>	
Geographical range	<p>Thrives in Northwestern North America's and Northeast Asia's mountain meadows</p> <p>Inhabited states in the USA are the following; Washington, California, Utah, Montana, Wyoming, and Colorado Inhabited counties in WA are the following; Okanogan, Chelan, Snohomish, Clallam, and Jefferson</p>
Ecological distribution	<p>-Fir-spruce ecosystems -Lodgepole pine ecosystems -Alpine ecosystems</p> <p>within the; -Cascade Mountains -Sierra Mountains -Northern Rocky Mountains -Middle Rocky Mountains</p>
Climate and elevation range	<p>Shallow and rocky soils at middle to low elevations. More specifically growing in mesic tundra meadows, rocky slopes, and glacial moraines in alpine zones anywhere from sea level to 12,000 feet with substrates consisting of sandstone and granite. Boreal sagebrush prefers to live in snow melt communities where snow accumulates in between their rocky habitats, thus protecting them from the harsh winter winds.</p>
Local habitat and abundance	<p>Habitat types include subalpine, alpine Fell-field, tundra, grass, sedge, alpine meadows. In Washington they are most found in thimbleberry-fireweed subalpine communities between 5,550 and 7,500 feet. However, in other regions they are known to thrive with willows, lichen grass communities, a variety of sedges, Kamchatka rhododendron, alpine pussytoes, horsetails, and arctic bluegrass.</p>
Plant strategy type / successional stage	<p>Tolerates wind and needs it for seed dispersal. Can also live in harsh desert conditions and shrub steppes that are extremely hot in the summer and very snowy in the winter, so it tolerates a variety of climates. It has been seen as an early successional developer in willow dominated areas, but quickly dies off as it is extremely susceptible to flooding and erosion. Wind dispersal leads to productive reseeding following a fire making it moderately affective in surviving burned areas. However, this early successional development is also short lived due to the risk of canopy cover by neighboring tree regrowth. It's native arctic regions are known to have a photoperiod of over 14 hours a day</p>

	Ultimately boreal sagebrush is tolerant to wind, acid soil pH, drought, intense sunlight, violent storms, and heat stress making it an extremely resilient species.
Plant characteristics	<p>Perennial native subshrub that grows from 8 to 24 inches in height. It has woody roots and smooth green to red herbaceous stems. The leaves are traditionally 5-8sm long and 2cm wide. They are arranged in a circular pattern around the stems base. The shrub develops florets in hundreds of bunches of 2-70 with each floret carrying a single yellow seed. This means that hundreds to thousands of seeds can be dispersed by wind depending on the plants size. It flowers from June to September.</p> <p>There are many synonyms to this plant because of its large range that allows for reclassification and a growing number of subspecies.</p>
<b>PROPAGATION DETAILS</b>	
Ecotype	These plants are yet to be successfully harvested and scaled up for mass production and retail. Many authors see this as a missed opportunity and write about how these boreal sagebrush seeds hypothetically could be grown. This is not an experimentally derived protocol, but instead suggestions on how an experiment could take place based on the plant's natural habitat and characteristics.
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Time to Grow	39 weeks
Target Specifications	Germinant that are over 4 inches long with a strong rooting system and can be transplanted directly into the ground with the ability to survive the winter and flower the following summer
Propagule Collection Instructions	Since the seeds are dispersed by wind and force the proper method for seed collection is through beating or stripping the productive floret bundles into bags between June and September while the plant is flowering.
Propagule Processing/Propagule Characteristics	Seeds are non-dormant, and their longevity is short lived meaning there is not a seed bank for this genus as seed lots only hold viability for up to two years. With adequate propagule processing viability can last up to 5 years, but this is rare.
Pre-Planting Propagule Treatments	Cleaning consists of a screening process that removes unwanted debris and increases purity. Since the seeds are so small screening is relatively effective in removing any biproducts of the beating procedure. Germination occurs at 18 degrees Celsius so they must be stores in a cool (<10 degrees Celsius) and in a dark area. A moisture content of 6-8% is ideal for dormancy as there must be low humidity to prevent early germination or rotting. The plants pericarp that is designed to aid in wind dispersal must be removed before storage to reduce the seeds moisture content. Storage typically lasts for a year after collection until the following season when they are ready to plant.
Growing Area Preparation / Annual Practices for Perennial Crops	In its native environment <i>Artemisia arctica</i> species prefers moderately dry and well drained soils so the media would need to have a higher percentage of sand or perlite. The characteristics of the media would include good drainage, sterile, and aerated. Sagebrush species have been successfully grown in containers and as bareroot stock. The recommended container size is 288 plug trays, and they can be sown uncovered.
Establishment Phase Details	Seeds of sagebrush populations from long and snowy winters tend to be dormant, light-requiring, or slow to germinate at warmer autumn temperatures. Whereas seeds of sagebrush populations from habitats with short, mild winters and hot, dry springs are dispersed later in the year while typically being nondormant, not light-requiring, and quick to germinate. The arctic sagebrush native to Washington is known to be slower to germinate because it lives in areas with high snowpack and hotter summers thus a two-

	<p>week stratification at 3°C is critical. Germination testing for sagebrush species consists of a 21-day test at 15 or 20 °C and a two-week stratification at 3 °C for more dormant seeds that are slow to germinate. The viability of ungerminated seeds should be examined with tetrazolium. This is important to do because this plant is lacking evidence and research that supports a concrete growing method for each individual sub-species of sagebrush.</p>
<p>Length of Establishment Phase <b><u>Weeks 1-3</u></b></p>	<p>Seeds of montane and snow-packed populations may take 20 weeks or more to germinate under conditions simulating stratification, whereas boreal sagebrush of warm desert populations may do so in as little as 1 week. If in a temperature-controlled greenhouse germination can be achieved in <b>3 weeks</b>.</p>
<p>Active Growth Phase</p>	<p>Following germination, the plants would require a long day photoperiod (&gt;14 hours) that mimics their native habitat in the spring and summer. It is recommended that the germinated plants are moved to a mist bench that lightly sprays them once every ten minutes. There should also be high light intensity and a constant temperature of 17°C. They should remain in the same soil media as before.</p>
<p>Length of Active Growth Phase <b><u>Weeks 3-7</u></b></p>	<p>The length of the active growth phase lasts <b>4 weeks</b> until they are ready to be hardened-off and able to eventually survive being transplanted. Since the plant is so resilient, they grow rapidly following germination and reach maturation quickly.</p>
<p>Hardening Phase</p>	<p>The practice of transplanting boreal sagebrush has been particularly successful as it is a sturdy plant that is tolerant and resilient out many environmental factors. The growing media should be changed in week 7 from germination media to a well-drained and synthetic media that contains sand and perlite for exceptional drainage. The new soil should have a pH of 6.5 and the fertilizer used (if any) should be 50:50 Nitrate/Ammonium and Calcium-Magnesium. The temperatures for the hardening phase should be 20-25°C during the day and 15-20°C at night. It is important that during the hardening phase there is a drop in temperate for 2 to 3 hours in the morning (during sunrise) that is 10°C.</p>
<p>Length of Hardening Phase <b><u>Weeks 7-9</u></b></p>	<p>The hardening phase lasts <b>2-3 weeks</b> before acclimation to new soil and temperatures has occurred and the plant is ready to be transplanted. Since the plant is a perennial, it will continue to grow for years to come following the transplant.</p>
<p>Harvesting, Storage and Shipping</p>	<p>Shipping would be expensive for this plant as it requires a large container size called “standard #1 nursery pots”. They must be transported quickly as they require a large amount of light that cannot be provided during transport. Lack of adequate lighting is their one big weakness.</p>
<p>Length of Storage</p>	<p>Ideally the plant is germinated in early July so that can be planted by the end of September. Storing the plant is difficult because it requires both harsh winters and hot summers in Washington to survive and those can be difficult to mimic indoors. The whole germination to out planting process takes 9 weeks since it is such a sturdy seedling given it receives enough sunlight.</p>
<p>Guidelines for Outplanting / Performance on Typical Sites</p>	<p>10 or more weeks of vernalization at 5°C cooler is needed to induce flowering during out planting. However, boreal sagebrush does not flower until its second year so the vernalization period is only required in the following season. Must be planted somewhere rocky, dry, and in direct sunlight.</p>
<p>Other Comments</p>	<p>Keep in mind that this plant has not been commercially produced at a large scale by nurseries and that most of this research speculates how boreal sagebrush potentially could be a great nursery plant as it is hardy and blooms dainty yellow flowers every summer.</p>

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Protocol Author	Cassidy Pearson
Date Protocol Created or Updated	05/04/2022