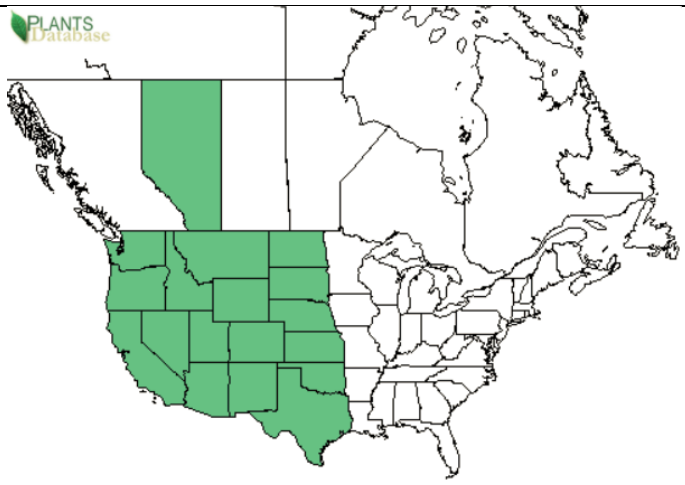
Plant Propagation Protocol for *Atriplex canescens*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/ATCA2.pdf

TAXONOMY	
Plant Family	
Scientific Name	Chenopodiaceae[12]
Common Name	Goosefoot family[12]
Species Scientific Name	
Scientific Name	*Atriplex canescens* (Pursh) Nutt.[12]
Varieties	*Atriplex canescens* var. *angustifolia* (Torr.) S. Watson *Atriplex canescens* var. *canescens* (Pursh) Nutt. *Atriplex canescens* var. *gigantea* S.L. Welsh & Stutz *Atriplex canescens* var. *laciniata* Parish *Atriplex canescens* var. *linearis* (S. Watson) Munz *Atriplex canescens* var. *macilenta* Jeps.[12]
Sub-species	None recognized in USDA Plants Database.[12]
Cultivar	*Atriplex canescens* 'Marana' *Atriplex canescens* 'Rincon' *Atriplex canescens* 'Santa Rita' *Atriplex canescens* 'Wytana'[11]
Common Synonym(s)	*Calligonum canescens* Pursh[4]
Common Name(s)	fourwing saltbush, chamise, chamize, chamiza, chamiso, white greasewood, salt sage, fourwing shadscale, bushy atriplex, buckwheat shrub, wafer sagebrush, box brush, hoary saltbush[5,11]
Species Code (as per USDA Plants database)	ATCA2[12]
GENERAL INFORMATION	
Geographical range	North American distribution This species is found in the Western United States, from the West Coast to the Great Plains, as well as Alberta, Canada.[11]

	 Map from USDA Plants Database[12] <u>Washington state distribution</u> This species is native to Washington state, but no maps of its county distribution are available.[12] Three herbaria specimens of this species have been cataloged in the Consortium of Pacific Northwest Herbaria database.[1] The specimens were collected in Yakima County between 1959 and 1961. The location of one of these specimens has been georeferenced and is depicted on the map below.[1] Although it is unknown whether the population in Yakima County is still present, a population near Spokane has been recently documented.[10]  Map from Consortium of Pacific Northwest Herbaria Specimen Database[1]
Ecological distribution	Prairies, plains and desert grasslands, shrublands, sagebrush, and other arid rangelands[7]

Climate and elevation range	Grows at a range of elevations, from below sea level to above 8500 ft.[7] Does best in arid climates. Typically found in regions with 8-14 inches of rain per year, but no seed crop will be produced in years with less than 10 inches of rain.[11]
Local habitat and abundance	Grows in a variety of habitats, including plains, valleys, hilltops, and riversides. Not found in areas with high water tables or very shallow soils.[7] Varying degrees of polyploidy may account for this species' ability to tolerant many habitats. One study reported a correlation between the ploidy of a subpopulation and the texture of the soil that the plants were growing on. Diploid plants were most common on sandy soils, while hexaploidy plants were found on dense floodplain soils. Tetraploid plants were found on multiple fine-grained soil types. *A. canescens* is known to have high genetic diversity and phenotypic plasticity.[3] Found in plant communities with prairie grasses, desert shrubs, and sagebrush.[7]
Plant strategy type / successional stage	Early successional, stress-tolerant species. One study on *A. canescens* in the Grand Canyon reported high recruitment and mortality rates over the course of a century. Uncommon in late successional communities.[2] Often found in saline soils, hence the common names salt sage and four-winged salt bush. Tolerates a wide range of soil types, severe cold and drought, and herbivory of up to 50% of new growth.[11]
Plant characteristics	Bushy evergreen shrub. 1-2 m tall with alternate, sessile leaves with entire margins. Commonly hybridizes with other *Atriplex* species.[4] Dioecious. Male and female flowers on panicles bloom from June to August. The fruit is an utricle with four winged bracts, hence the common name four-winged saltbush.[5] Seed is the most common method of propagation in nature, though the plant is capable of layering and root sprouting. Young plants grow very fast, as much as 1.5 feet in their first year.[11]

	Although researchers have documented a few individuals that have lived over a hundred years, most *A. canescens* plants live less than three decades.[2,6]
PROPAGATION DETAILS	
Cuttings, as described by Wiesner and Johnson[13]	
Ecotype	Cuttings were taken from male and female plants at the Bridger Plant Materials Center and Wade Creek. Both locations are close to Bridger, Montana, which has a dry climate.
Propagation Goal	Plants
Propagation Method	Vegetative
Product Type	Container (plug)
Stock Type	Pots. No details specified about dimensions.
Time to Grow	Established roots formed in 5 weeks.
Target Specifications	Cuttings with established roots
Propagule Collection Instructions	Cuttings were taken from the ends of new stems of healthy male and female plants.
Propagule Processing/Propagule Characteristics	Cuttings were 7.6 cm long and 1-3 mm wide.
Pre-Planting Propagule Treatments	Cuttings were soaked in Hoagland's complete nutrient solution for 24 hours. Subsequently, rooting was stimulated by applying Hormodin #2, which contains 0.3% indolebutryric acid, to the proximal ends of cuttings.
Growing Area Preparation / Annual Practices for Perennial Crops	Cuttings were grown on a greenhouse mist bench in a 1:1 mix of sand and peat. At 10 cm deep, the media temperature was a constant 20ºC.
Establishment Phase Details	93% of male cuttings and 90% of female cuttings formed roots. Soaking cuttings in Hoagland's complete nutrient solution increased rooting success by 9%.
Length of Establishment Phase	Established roots formed in 5 weeks.
Active Growth Phase	Rooted cuttings were transplanted to flats with a 3:1 mix of sand and peat. Flats were kept on the mist bench for 2-3 days after transplanting to reduce transplant shock. Next, the plants were removed from the mist bench and kept in a different area of the greenhouse with an air temperature range of 20-25ºC. Cuttings received water every 4-5 days. To promote lateral branching, the tips of apical meristems were snipped three weeks after transplanting the cuttings.
Length of Active Growth Phase	Information not provided.
Hardening Phase	Information not provided.
Length of Hardening Phase	Information not provided.
Harvesting, Storage and Shipping	Information not provided.
Length of Storage	Information not provided.

Guidelines for Outplanting / Performance on Typical Sites	Information not provided.
Other Comments	Pay close attention to soil moisture levels. Overwatering will negatively impact root growth. It is important to use a rooting hormone specifically for woody plants. Applying a rooting hormone manufactured for non-woody species will lower rooting success.
Seed, as described by Meyer and Carlson[8]	
Ecotype	Seeds were collected from a total of 23 different populations in creosote bush shrubland, blackbrush shrubland, salt desert shrubland, sagebrush steppe, and mountain brush habitats in Arizona, Nevada, Utah, and Idaho.
Propagation Goal	Germinants
Propagation Method	Seed
Product Type	No product
Stock Type	100 mm Petri dishes
Time to Grow	Information not provided.
Target Specifications	Emergence of radicle from seed.
Propagule Collection Instructions	Seeds were collected in fall.
Propagule Processing/Propagule Characteristics	53% of fruits were filled with seed. 52% of the collected seed was initially viable. Seed viability did not significantly decrease after six years of storage at 20-22ºC and 30-35% relative humidity in open containers.
Pre-Planting Propagule Treatments	After collection, bracts were removed from the seeds using a rubbing board. Chaff was separated from seed by screening and fanning. Treatments to break physiological dormancy began 3-8 weeks after the seeds were collected. Fruits were sandwiched between moistened blue germination blotters in 100 mm Petri dishes. Depending on the treatment group, seeds received 0, 4, or 24 weeks of cold moist stratification at 2ºC in a dark cold room. There were 8 sets of 25 fruits per treatment group. Seed dormancy for *A. canescens* can be broken using a period of cold moist stratification or after-ripening. For the second experiment, seeds were placed in dry storage for 1, 2, 6, or 10 years at 20-22ºC and 30-35% relative humidity to allow for after-ripening. After storage, some seeds in a group received the cold moist

	stratification treatment described above, while others did not.
Growing Area Preparation / Annual Practices for Perennial Crops	After stratification, seeds were kept in the dark at 15ºC and percent germination was tracked weekly.
Establishment Phase Details	For populations growing in colder regions such as mountain brush, the duration of seed dormancy was higher and the ability of seeds to germinate was lower. For colder regions, seeds that received longer durations of cold moist stratification had higher germination rates when the duration of seed storage was two years or less. In contrast, seeds from the warm creosote bush shrubland required dormancy treatments ranging from none to short durations of cold moist stratification or after-ripening. For other intermediate habitats between these two extremes, the duration of seed dormancy and the best dormancy treatment varied considerably depending on the source population.
Length of Establishment Phase	Up to 4 weeks
Active Growth Phase	Information not provided.
Length of Active Growth Phase	Information not provided.
Hardening Phase	Information not provided.
Length of Hardening Phase	Information not provided.
Harvesting, Storage and Shipping	Information not provided.
Length of Storage	Information not provided.
Guidelines for Outplanting / Performance on Typical Sites	Information not provided.
Other Comments	Seeds may exhibit high or no physiological dormancy. Knowing the ecotype of the seed source is key to determining the best treatment and duration for breaking seed dormancy, whether it be cold moist stratification, after-ripening, or a combination of both.
Micropropagation, as described by Reyes-Vera, Lucero, and Barrow[9]	
Ecotype	Information not provided.
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	Information not provided.
Time to Grow	90+ days
Target Specifications	Shoot and root formation from tissue culture. Plant does not suffer from hyperhydricity, which occurs when high humidity and nitrogen concentrations in tissue cultures cause physical deformations.
Propagule Collection Instructions	Ripe seeds can be collected beginning in late fall. Once the species is located, seed collection should not be

	difficult. Seeds may persist on plants for months, and plants usually produce large quantities of seed.
Propagule Processing/Propagule Characteristics	Seeds are enclosed in an utricle with four bracts.
Pre-Planting Propagule Treatments	Using sterile nail clippers, separate the seed from the bracts and utricles. Place the seeds in a closed container filled with a 1:100 solution of Zerotol and sterile water. Agitate the solution for ten minutes. This disinfection step is extremely important for successful tissue culture.
Growing Area Preparation / Annual Practices for Perennial Crops	The tissue culture media should be kept at a constant pH of 5.6. Use a media composed of 2.4 g/l woody plant media, vitamins, 30 g/l sucrose, 5 mg/l purine, and 0.8% plant tissue culture grade agar. The media should be placed in polycarbonate culture boxes with 10 mm opening slots for venting. Cover slots with polypropylene plastic. It is important to use culture boxes that are vented rather than completely closed to lower humidity levels inside the culture. High humidity levels could lead to hyperhydricity. Culture boxes should be placed in a controlled environment with a constant 28ºC temperature, 16 hours of daylight, and 14-18 photosynthetic photon flux density (PPFD).
Establishment Phase Details	Sterile conditions are essential to prevent the formation of bacteria colonies in the tissue culture.
Length of Establishment Phase	Shoots should form in 30 days.
Active Growth Phase	To maintain sterile conditions and ensure adequate nutrients are available, the tissue culture media should be replaced every 30 days.
Length of Active Growth Phase	Adequate root formation in 60 days.
Hardening Phase	To minimize transplanting shock, the hardening phase must be conducted as a multistep process. First, the plants should be transplanted to sterilized moist peat pellets, but kept in the growth chamber. Once roots are visible on the outside of the peat pellets, transplant the plants to potting soil and keep them in the greenhouse at a temperature between 20-30ºC.
Length of Hardening Phase	Information not provided.
Harvesting, Storage and Shipping	Information not provided.
Length of Storage	After transplanting, plants can be kept in the greenhouse for up to one year.
Guidelines for Outplanting / Performance on Typical Sites	This treatment has resulted in successful outplanting in New Mexico.

Other Comments	Since this species is adapted to infertile soils, there is no need to fertilize the plants once they are transplanted out of the tissue culture. This protocol will also work for tissue cultures with apical shoots, and may work for other types of tissue.
INFORMATION SOURCES	
References	See Below
Other Sources Consulted	See Below
Protocol Author	Kyra Kaiser
Date Protocol Created or Updated	04/16/18

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