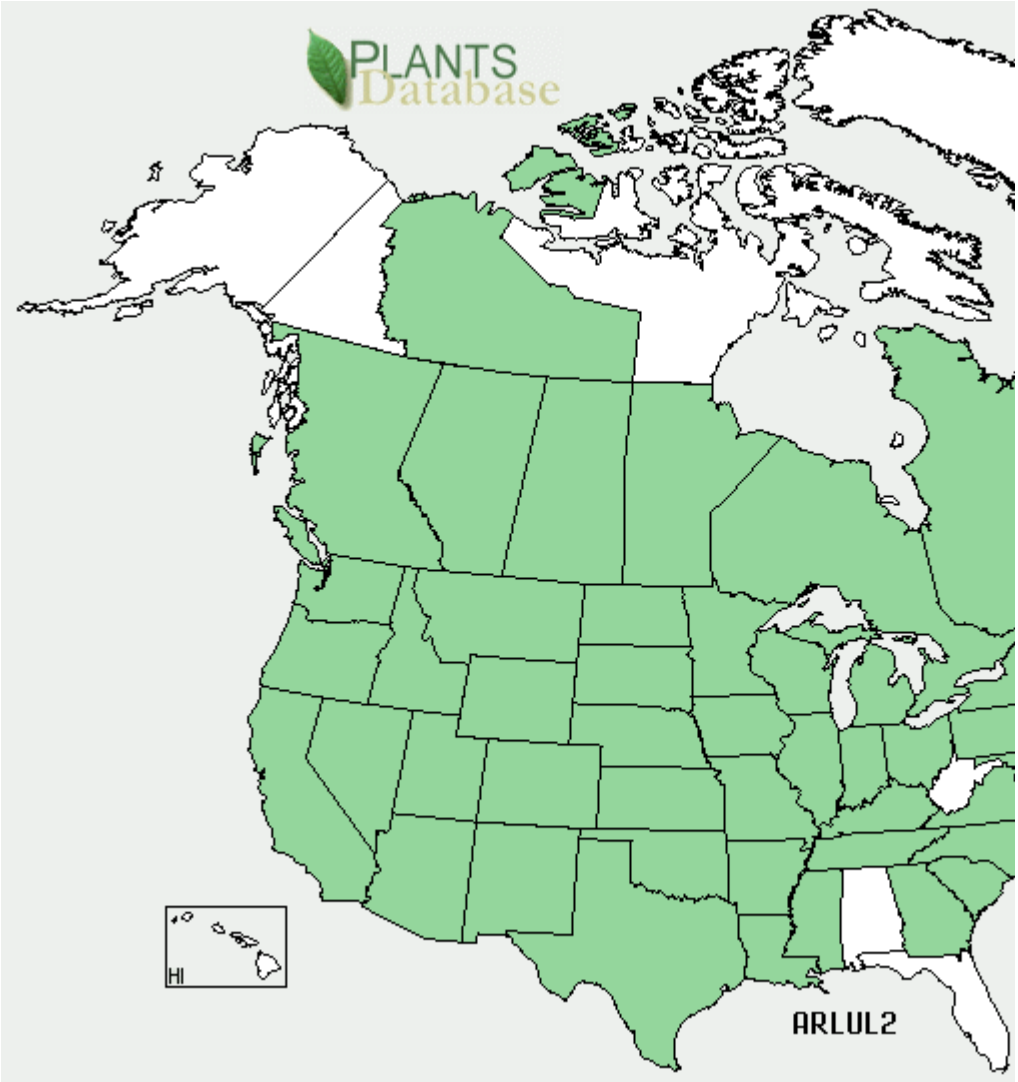
Plant Propagation Protocol for Artemisia ludoviciana Nutt.
D. Giselle Koehn
ESRM 412 – Native Plant Production

TAXONOMY	
Family Names	
Family Scientific Name:	ASTERACEAE
Family Common Name:	Sunflower Family
Scientific Names	
Genus:	*Artemisia*
Species:	*ludoviciana* Nutt.
Species Authority:	Not Found
Variety:	var. *latiloba*, var. *ludoviciana*, and var. *incompta*
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	Not Found
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	ARDI15 *Artemisia diversifolia* Rydb. ARGN *Artemisia gnaphalodes* Nutt. ARHE6 *Artemisia herriotii* Rydb. ARLUT *Artemisia ludoviciana* Nutt. ssp. *typica* D.D. Keck ARLUA3 *Artemisia ludoviciana* Nutt. var. *americana* (Besser) Fernald ARLUB *Artemisia ludoviciana* Nutt. var. *brittonii* (Rydb.) Fernald ARLUG *Artemisia ludoviciana* Nutt. var. *gnaphalodes* (Nutt.) Torr. & A. Gray ARLUL3 *Artemisia ludoviciana* Nutt. var. *latifolia* (Besser) Torr. & A. Gray ARLUP *Artemisia ludoviciana* Nutt. var. *pabularis* (A. Nelson) Fernald ARPA23 *Artemisia pabularis* (A. Nelson) Rydb. ARPU12 *Artemisia purshiana* Besser ARVUL2 *Artemisia vulgaris* L. ssp. *ludoviciana* (Nutt.) H.M. Hall & Clem. ARVUL3 *Artemisia vulgaris* L. var. *ludoviciana* (Nutt.) Kuntze (2)
Common Name(s):	Western sage, White Sage, western mugwort, prairie sagebrush, Artemisia, silver queen, wormwood
Species Code (as per USDA Plants database):	ARTLUD
GENERAL INFORMATION	
Geographical range	*ludoviciana* occurs from low to high elevations, from B.C. to California and Mexico, east to Ontario, Illinois, and Arkansas. It is not found west of the

(distribution maps for North America and Washington state)	Cascades, except as an occasional introduction. It occupies dry open sites and disturbed areas from the plains and foothills to the alpine zone in the mountains. White sage is a diverse species, with several subspecies that intergrade in areas of overlapping occurrence.(1) *Artemisia ludoviciana* Nutt. ssp. *ludoviciana*  View Native Status Present Absent
Ecological distribution (ecosystems it occurs in, etc):	prairie, desert, dry mountain meadows
Climate and elevation range	Grows in areas of Low water, dry to mesic, rocky, shallow soils, and in areas exposed to full sun(2).

	It has a Cold hardiness rating as USDA Hardiness Zone 3, and has high CaCO3 Tolerance:
Local habitat and abundance; may include commonly associated species	Dry slopes; canyons; open, pine woods; dry prairies(2) In Washington State it is found in dry mountain meadows of the Cascades, and in Olympic Mountains (5). Prairie grass species are commonly associated.
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	Spreads rapidly to form colonies (weedy) (2) Stress Tolerator (high light low moisture)
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	A perennial with mostly stem leaves that are lance shaped, mostly entire and white woolly on the upper surface (sometimes underside as well) (5).
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants
Propagation Method	Seed

(Options: Seed or Vegetative):	
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container (plug)
Stock Type:	160 ml container
Time to Grow (from seeding until plants are ready to be out planted):	8 Months
Target Specifications (size or characteristics of target plants to be produced):	Height: 6 to 10 true leaves, 5 cm Caliper: n/a Root System: firm plug in 160 ml container
Propagule Collection (how, when, etc):	Seeds are hand collected from early October to early November when achenes turn brown and are easily removed from the disc. Seeds must be collected as soon as seeds ripen. Harvesting too early or too late collection often results in the collection of non-viable or aborted seeds. Collections should be spread evenly over a tarp to dry for 3 to 5 days. Other Accounts of seed harvest, collection and treatment mention difficulties getting sufficient amounts of seed and trouble with weevil predation. In this case seed heads were hand pruned and placed in bags to dry. On office brush machine with a sandpaper drum cleaned the seeds (3)
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Seed longevity is 5 to 7 years in sealed containers at 1C. Seed dormancy is classified as non dormant. Seeds/kilogram: 6,600,000/kg % Purity: 100% % Germination: 86% (1)
Pre-Planting Propagule Treatments (cleaning, dormancy	60 to 90 day cold, moist stratification. Seeds are placed on moist paper towels inserted into an opened Zip-lock bag and placed in the refrigerator at 1 to 3 C (1). Another account references moist stratification for 14 days (3).

treatments, etc):	
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	Greenhouse. Sowing Method: Direct Seeding. Seeds are surface sown. Growing medium used is milled sphagnum peat, perlite, and vermiculite and 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 1 gram of Osmocote and 0.20 gram of Micromax per 172 ml container (1). In a separate account Seeds were sown into containers of moistened media (sunshine#1which is peat based) amended with micronutrients (micromax) and a balanced slow release fertilizer (3).
Establishment Phase (from seeding to germination):	Medium is kept slightly moist during germination. Seeds germinate at greenhouse temperatures set at 21 C during the day and 15 C at night. Seedlings are thinned at this stage. After seedlings are established, they must dry down between irrigations (1).
Length of Establishment Phase:	4 weeks
Active Growth Phase (from germination until plants are no longer actively growing):	Seedlings were fertilized with 20-20-20 liquid NPK fertilizer at 100 ppm during the growing season. Plants were fully root tight 12 weeks after germination. Plants were 4 cm in height with 10 to 12 true leaves (1).
Length of Active Growth Phase:	8 weeks
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 are leached with clear water and fertilized with 10-20-20 liquid NPK fertilizer at 200 ppm once before winterization (1).
Length of Hardening Phase:	4 weeks (1)
Harvesting, Storage and Shipping (of seedlings):	Total Time to Harvest: 6 months Harvest Date: September Storage Conditions: Overwinter in outdoor nursery under insulating foam cover and snow (1).
Length of Storage (of	

seedlings, between nursery and outplanting):	
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	
Other Comments (including collection restrictions or guidelines, if available):	Can be propagated from root cuttings or stems. It is propagated from root cuttings or stems. (4) Vegetative Propagation Method: *A. ludoviciana* is rhizomatous and can be propagated by divisions (1). Increase seed Yield by sowing seeds or dividing the rhizomes in spring or fall. Mature plants may also be divided (2). Uses: *A. ludoviciana* readily establishes on road shoulders and exposed slopes. It increases by rhizomes and is rated as good for erosion control and slope stabilization. It is also used for purification rights in Many Native American Tribes, and is cited as having antidihareal properties (1,2,4). Negative Affects: Is associated with allergies due to pollen Notes: There is evidence of special Phosphate exchange between this species, arbuscule endomycorrhizal fungi, and other Prairie plants
INFORMATION SOURCES	
References (full citations):	1.) Luna, Tara; Evans, Jeff; Wick, Dale. 2008. Propagation protocol for production of container *Artemisia ludoviciana* Nutt. var. *latiloba* Nutt. plants (160 ml container); USDI NPS - Glacier National Park, West Glacier, Montana. In: Native Plant Network. http://www.nativeplantnetwork.org (8 May 2008) 2.) PLANTS Profile from Natural Resources Conservation Service http://plants.usda.gov/java/profile?symbol=ARLU(accessed 8, May2008) 3.)Amy Bartow Olympic National Park Hurricane Ridge Road Project 2004 Annual Season Summary Natural Resources Conservation Service, Corvalis Plant Materials Center (accessed online 11, may 2008) 4.) Greenbeam.com (accessed 10, May 2008)

	5.) J. Pojar, A. MacKinnon Plants of the Pacific Northwest Coast Revised Lone Pine publishing,1994 Vancouver B.C
Other Sources Consulted (but that contained no pertinent information) (full citations):	Flora of the Pacific Northwest, Hitchcock and Cronquist, 7th edition, University of Washington Press, 1973. Wilson, G. W. T.[1], Hartnett, D. C.[1]Rice, C. W.[2] Mycorrhizal-mediated phosphorus transfer between tall grass prairie plants Sorghastrum nutans and Artemisia ludoviciana. Functional Ecology; Jun2006, Vol. 20 Issue 3, p427-435 Zavala-Sánchez, Miguel A.,Pérez-Gutiérrez, Salud,Pérez-González, Cuauhtemoc,Sánchez-Saldivar, David, Arias-García, Lucina Antidiarrhoeal Activity of Nonanal, an Aldehyde Isolated from Artemisia ludoviciana. Pharmaceutical Biology; Jun2002, Vol. 40 Issue 4, p263, 6p Hassell, Wendel, U.S.D.I. and U.S.D.A., Seeding Rate Statistics for Native and Introduced Species April 1996. AOSA. Updated 2006. *Suggested purity and/or germination testing methods for species AOSA Rules testing procedures*. Association of Official Seed Analysts, Stillwat Also available online at http://www.aosaseed.com/reference.htm. (accessed online 11, May 2008) The Browse-Shrub and Forb Committee of the Association of Official Seed Analysts. *F on seeds of browse-shrubs and forbs*. Association of Official Seed Analysts and Forest Service, Atlanta, GA. Available online at http://www.nsl.fs.fed.us/Handbook%20on%20Seeds%20of%20Browse-Shrubs%20and%20Forbs.pdf. (accessed online 11, may 2008) Vance, N.C., M. Borsting, D. Pilz, and J. Freed. 2001. *Special forest products: species information guide for the Pacific Northwest*. PNW-GTR-513. USDA Forest Se Portland, OR. Available online at http://www.fs.fed.us/pnw/pubs/gtr513/ (accessed online 11, May 2008) *Native Plants Journal* (http://www.nativeplantnetwork.org/journal/) (11, May 2008) The University of Texas @ Austin http://www.wildflower.org/plants/result.php?is_plant=ARLU (accessed 11, May 2008)
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