Plant Propagation Protocol for *Arbutus Menziesii* (Pacific madrone)
ESRM 412 – Native Plant Production
Spring 2008

TAXONOMY	
Family Names	
Family Scientific Name:	*Ericaceae*
Family Common Name:	Heath Family
Scientific Names	
Genus:	*Arbutus*
Species:	*menziesii*
Species Authority:	Pursh
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (may repeat this section multiple times as needed)	
Genus:	*Arbutus*
Species:	*procera*
Species Authority:	Douglas. non Sol.
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Name(s):	Pacific mandrone, madrona, madrono, bearberry, strawberry tree
Species Code (as per USDA Plants database):	ARME
GENERAL INFORMATION	
General Distribution (geographical range (states it occurs in), ecosystems, etc):	Located in coastal areas of British Columbia, Washington, Oregon, and California. Also found less frequently in the Sierra Nevada Range at middle elevations.[1]
Climate and elevation range	Humid coastal sites(100 - 1500m) with dry summers and mild winters.[2]
Local habitat and abundance; may include commonly associated species	Grows in a variety of soils, but most abundant in poor well drained soils[3]. Commonly found in association with lodgepole pine, western hemlock, and Douglas fir in Washington[5] and oak species in California[3].
Plant strategy type / successional	Early successional and subclimax favoring

stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	establishment after disturbances. Tolerates poor soils, but has low shade tolerance during establishment[6].
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 (Options: Seed or Vegetative):	Seed
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	Container, bareroot
Stock Type:	1 gallon
Time to Grow (from seeding until plants are ready to be outplanted):	Seedlings can be outplanted as early as 1 year[8].
Target Specifications (size or characteristics of target plants to be produced):	Seedlings should be outplanted when they reach 2 feet tall[1].
Propagule Collection (how, when, etc):	Seed collection begins when berries are a deep red color from mid-October to mid-November[9]. Each fruit contains roughly 8 seeds. Mature seeds have a black to blackish brown color while immature seeds are a white or tan color. Fruits can be collected from low branches and should be placed in breathable containers[8]. It is best to collect fruits when they are ripe, but before herbivory removes much of the fruits[8].
Propagule Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	Seeds weigh approximately 2000 seeds/pound[4] and dried seeds can be stored up to 2 years at room temperature[1]. Seeds should be stored in cool, dark, and dry storage(~5^{o}c)[8].
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	Seeds first should be removed from berries before other pre-planting treatments can be applied. The wet method of extracting the seeds involves macerating the fruits and using wire screens to separate the seed from pulp. A dry method of crushing dried fruits into a powder and using screens to filter the seeds out.[8] After seeds have been sorted from the fruit they should be cold stratified. Trials have inferred that *Arbutus*

	Menziesii has physiological dormancy[10] and benefits from cold stratification. Seeds have shown to reach maximum germination rates at 40 to 60 days of cold stratification. In this study, seeds were stratified at 4°c in a moist peat-vermiculite mix soil[8]. Seeds have shown to have germination rates of 94% after 60 days of cold stratification in other studies[3].
Establishment Phase (from seeding to germination):	Sow in a peat vermiculite mix
Length of Establishment Phase:	2 to 3 months with cold stratification.[8]
Active Growth Phase (from germination until plants are no longer actively growing):	Successful nursery-style production was achieved by transplanting seedlings into 2.25in. mesh liner pots after growing 2 to 4 true leaves. The growing medium used was a Douglas-fir (Pseudotsuga menziesii) bark and peat moss(4:1 by volume) and amended with micromax at the rate of 1038 g/m3(1.75 lb/ yd3). Over 1 year of growth, seedlings can be moved to larger containers as needed and into a Douglas-fir bark and sharp sand (2:1by volume) mixture. Care in transplanting is needed as menziesii are fragile. Transplanting should also be done in cooler weather to reduce possible infection of Phytophthora (damping off).[8]
Length of Active Growth Phase:	12 to 14 months
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):	Slowly reducing growing temperatures and fertilization over a series of months can help prepare seedlings for outplanting.
Length of Hardening Phase:	2-3 months. Fall.
Harvesting, Storage and Shipping (of seedlings):	Plants can be stored in containers close together in nursery conditions before shipping[8]. Plants should be outplpanted as soon as possible or should be moved into larger sized pots if stored for long periods of time so that the roots do not become potbound.
Length of Storage (of seedlings, between nursery and outplanting):	Can be stored for many months in larger containers and in favorable conditions, but should be outplanted as soon as possible.
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	Outplanting should be done on droughty soil and placed away from lawns and non-drought tolerant plants[1]. Percent survival is high for larger container plants. The production method from above resulted in high survival rates(100%) for a small sample size from the time of outplanting to 6 months afterwards. 1 gallon container plants have shown to grow 100% taller in 1 growing season[8] and other reports have madrones

	growing 3.7m over the first 3 growing seasons[3]. During the first few growing seasons, madrones should be deeply watered once a month during dry summer months.[1]Madrones reach maturity around age 8 where they flower and may produce seeds.
Other Comments (including collection restrictions or guidelines, if available):	Propagation by cutting has proven to be successful, but documentation is limited. Cuttings should be taken in the fall from semi-hardwood sections of the plant.[11]
INFORMATION SOURCES	
References (full citations):	See below
Other Sources Consulted (but that contained no pertinent information) (full citations):	
Protocol Author (First and last name):	Patrick Sowers
Date Protocol Created or Updated (MM/DD/YY):	04/15/08

[1] Diana L. Immel. *Pacific madrone* Plant Guide. USDA, NRCS, National Plant Data Center, c/o Plant Science Department, University of California, Davis, California

[2]Stuart, J. D., & Sawyer, J. O. (2001). *Trees and shrubs of California*. California natural history guides, 62. Berkeley: University of California Press.

[3]Reeves, Sonja L. 2007. *Arbutus menziesii*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, April 15].

[4]USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 15 April 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

[5]Fonda, R. W.; Bernardi, J. A. 1976. Vegetation of Sucia Island in Puget Sound, Washington. Bulletin of the Torrey Botanical Club. 103(3): 99-109. [62836]

[6]Krajina, V. J., Klinka, K., & Worall, J. (1982). *Distribution and ecological characteristics of trees and shrubs of British Columbia*. Vancouver, B.C.: University of British Columbia, Faculty of Forestry.

[7]Tappeiner, J.C., II, P.M. McDonald and T.F. Hughes. 1986. Survival of tanoak (Lithocarpus densiflorus) and Pacific madrone (Arbutus menziesii) seedlings in forests of southwestern Oregon. New Forests 1:43–55.

[8]Adams, A. B., & Hamilton, C. W. (1999). *The decline of Pacific madrone (Arbutus menziesii Pursh): current theory and research directions : proceedings of the April 28, 1995 symposium held at the Center for Urban Horticulture, University of Washington, Seattle, Washington & subsequent research papers*. Seattle, Wash: Save Magnolia's Madrones.

[9]Betty Young, 2007. Propagation Methods for Select Species of Northern California. Golden Gates National Parks.

[10]Baskin, Carol C.; Baskin, Jerry M. 2003. Propagation protocol for production of container Arbutus menziesii Pursh plants; University of Kentucky, Lexington, Kentucky. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 15 April 2008). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

[11]Bilderback, Ted E. and Bir Richard E. Nursery Crop Science: Propagation for Beginners. College of Agriculture and Life Sciences NC State University.

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