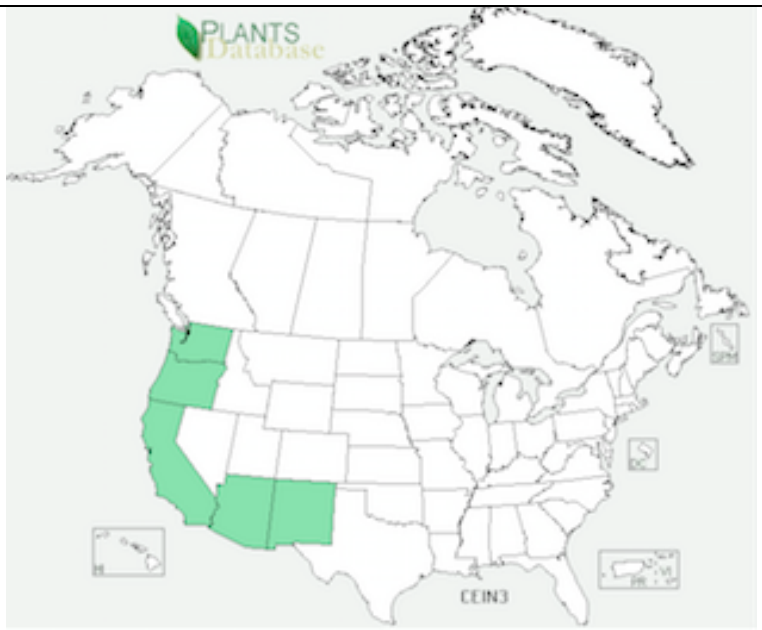
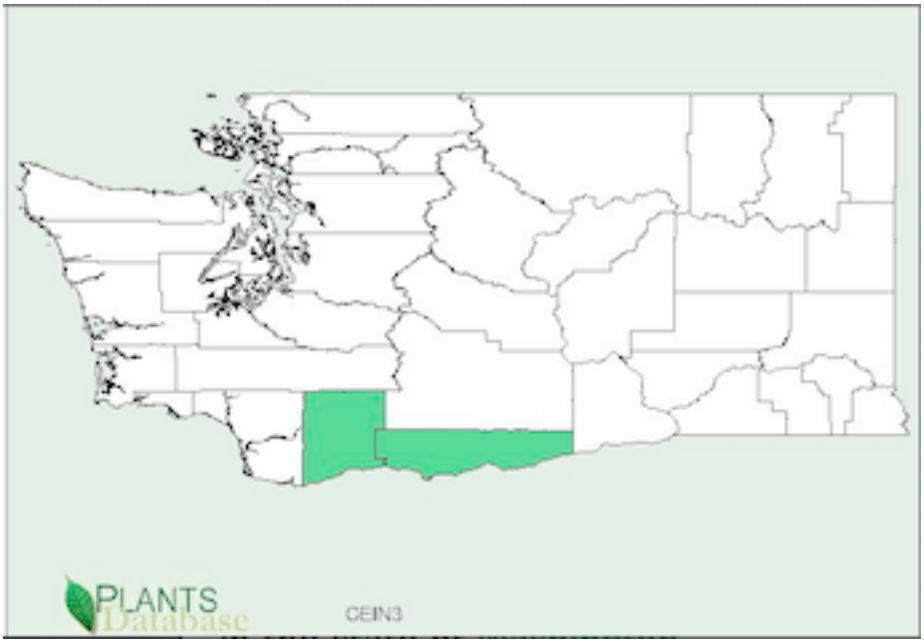
Plant Propagation Protocol for *Ceanothus integerrimus*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/CEIN3.pdf

TAXONOMY	
Family Names	
Family Scientific Name:	Rhamnaceae [14]
Family Common Name:	Buckthorn
Scientific Names	
Genus:	*Ceanothus*
Species:	*integerrimus*
Species Authority:	Hook. & Arn.[14]
Variety:	*macrothyrsus*
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	(Torr.) G.T. Benson[6]
Common Synonym(s)	*Ceanothus andersonii* Parry[14] *Ceanothus californicus* Kellogg [14]
Common Name(s):	Deerbrush, Sweet birch[6]], blue bush [6], buckbrush[12]
Species Code (as per USDA Plants database):	CEIN3 [14]
GENERAL INFORMATION	

Geographical range	 
Ecological distribution (ecosystems it occurs in, etc):	Douglas-fir Ponderosa pine Fir-spruce Western hardwoods Chaparral-mountain shrub[6]
Climate and elevation range	2,000-4,000 ft in northern CA, OR, WA 5,000-7,000 ft in southern CA[11]
Local habitat and abundance; may	Cascade Range from south central Washington to California. Most abundant in California, where distribution continues south to the

include commonly associated species	southern Sierra Nevada and west through the Klamath and North Coast ranges, the San Francisco Bay Area, and the South Coast, Transverse, and Peninsular ranges to Baja California. Disjunct populations are found in the Warner Mountains of California, central and southeastern Arizona, and west-central New Mexico [6] Shrub of open woods, usually in conifer-hardwood settings of Douglas-fir, yellow pine and Garry oak [8] Open, brushy slopes and roadsides[12] *Quercus garryana, Holodiscus discolor, Ribes* spp.,, *Chamaebaetia foliosus,* manzanitas [5]
Plant strategy type / successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	Fire successional and colonizer. Dominates areas after wildfires and seeds are adapted to remaining dormant for long periods in litter and soil seedbanks [15] Typically successional after fire, landslide, logging or mining. Dies out when overtopped by trees. If fires or other disturbances are frequent enough to prevent conifer establishment, *C. integerrimus* may occupy a site indefinitely. [6] Colonization after disturbance is further enhanced by its nitrogen-fixing capabilities.
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	Openly branched shrub, 3-18 feet tall, with broadly oval, drought-deciduous, broadly oval, alternate leaves that are 1-2 inches long, with entire margins and soft pubescence on both surfaces [6. 15] Stems, excluding the root crown, live about 35 years [6]
PROPAGATION DETAILS	
Ecotype:	Rogue River-Siskiyou National Forest, Gold Beach Ranger District, Indigo site, Gold Beach, OR: 3800 ft. elevation[1]
Propagation Goal):	Plants
Propagation Method):	Seed
Product Type	Container (plug)
Stock Type:	
Time to Grow (from seeding until plants are ready to be outplanted):	Data specific to this species was not available, however for a similar species (*C. velutinus)* the time to grow was 8 months[9]
Target Specifications (size or characteristics of target plants to be produced):	Data specific to this species was not available, however specifications for a similar species, (*C. velutinus),* could be used as a guideline Height: 15 cm, Caliper: 7 mm, Root System: root tight plug[9]
Propagule Collection	Seeds should only be collected from vigorous plants as weak plants do not produce sound seed. Tie cloth bags securely over the clusters of green seed pods. As the capsules split, the seeds are ejected with force.

	Seed pod clusters should not be cut as the seeds will not ripen properly and few prematurely collected seeds will germinate.[11] Fruit matures from June-August[11]
Propagule Processing/Propagule Characteristics:	Seed density is 70,000/lb [2, 11] Seeds are long-lived in forest soils, waiting for fire and forest clearing to germinate. Sealed containers kept at 40˚ F (4-5˚C) are satisfactory for storage[11] Viability of 90 % has been reported for 24 year old seed [J] and other researchers have suggested that *Ceanothus integerrimus* seed remains viable for up to 100 years.[3]
Pre-Planting Propagule Treatments	Seed lot is first processed using a Westrup Model LA-P Laboratory Clipper/De-awner to remove seed from capsule. Laboratory Test Sieves, mesh size 12 and 14 are used to remove stems and non seed material. Seed is then air-screened using an office clipper, top screen: 5 ½ round and a bottom screen 1/20 round, high speed and medium to high air.[1] Requires a dual treatment of hot water or sulfuric acid followed by a 2 month moist prechilling treatment at 3-5˚ C for maximum germination. Germination was 90% in 7 days with a 90˚ hot water dip (left in the water for two hours and allowed to cool gradually) followed by the 2 month stratification [G,L]. If using sulfuric acid, 15 or 30 minutes is sufficient; a one hour treatment caused some injury.[5] One trial testing the effects of wet vs. dry-heat on scarification and germination found all wet heat treatments above 45˚ C had 100% scarification, while in dry-heat (oven) treatments only exposure to 120˚C resulted in 100% scarification. Greatest germination was found for the water bath treatment at 90˚C for a duration of 8 minutes. This study further reported greater germination success for a 90 day stratification period over the 60 day period [7]
Growing Area Preparation / Annual Practices for Perennial Crops:	Seeding has been done in flats containing a medium of five parts loam, four parts peat and three parts sand. Seedlings are sensitive to sowing depth. Emergence was best when sown at a depth of ½ to 1 inch. Another study sowed treated seeds in 288-cell square deep-plug trays with Sunshine #1 mix and placed them in a greenhouse under 23˚C day, 15˚C night temperatures.[4]
Establishment Phase:	7 days if given the 2 month cold/moist stratification [5]
Length of Establishment	Data specific for this species was not available. An establishment phase of 1 month was found for similar species, which may be used as

Phase:	a guideline.[9]
Active Growth Phase	
Length of Active Growth Phase:	Data specific for this species was not available. An establishment phase of 3 months was found for similar species, which may be used as a guideline.[9]
Hardening Phase	Data specific for this species was not available. For a similar species, seedlings were moved to the outdoor nursery to undergo hardening until late fall.[9]
Length of Hardening Phase:	Data specific for this species was not available. For a similar species, it was 2-3 months, which may be used as a guideline.[9]
Harvesting, Storage and Shipping (of seedlings):	Cold storage, 33-38˚ F[1]
Length of Storage (of seedlings, between nursery and outplanting):	Data specific for this species was not available. 5 months for a similar species.[9]
Guidelines for Outplanting / Performance on Typical Sites:	*C. integerrimus*, outplanted as single stems at a site near Mt. Shasta, began to develop multiple stems from the root crown within a few weeks. 89% of the plants had multiple stems after one season. After one growing season, plants averaged 14 cm tall and after four seasons were 102 cm tall. Average crown width was 14 cm after one growing season and 130 cm after four seasons. Flowers first appeared in the third growing season with 42% producing flowers and 77% producing flowers in the fourth season. Survival was 83% after the first growing season with no subsequent mortality after the fourth season. Seedling mortality occurred in late summer or fall after supplemental fertilization and irrigation had ended.[10]
Other Comments:	For optimum nursery or field production, fall sowing is recommended [5]
INFORMATION SOURCES	
References:	1.Barner, J. 2009. Propagation protocol for production of *Ceanothus integerrimus* Hook. & Arn. Plants; USDA FS-R6 Bend Seed Extractory, Bend, Oregon. In: Native Plant Network. URL: http;//www.nativeplantnetwork.org (accessed 15 May 2014). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery. 2. Bonner FT and Karrfalt RP. 2008. The woody plant seed manual. Agriculture Handbook 727. USDA Forest Service. Washington (DC). [Internet]. [cited 2014 Apr 14]. Available from http://www.mgr.net/publications/wpsm 3. Cronemiller, FP. 1959. The life history of deerbrush-a fire type. Journal of Range Management. 12:21-25. 4. Dreesen DR and Harrington JT. 1997. Propagation of native plants

for restoration projects in the southwestern United States-preliminary investigations. In: Landis TD and Thompson JR, technical coordinators. National Proceedings, Forest and Conservation Nursery Associations. Gen. Tech. Rep. PNW-GTR-419. Portland (OR): U.S Department of Agriculture, Forest Service, Pacific Northwest Research Station:77-88.

5. Heit CE. 1970. Germinative characteristics and optimum testing methods for twelve western shrub species. Proceedings of the Association of Official Seed Analysts. 60: 197-205.

6. Howard JL. 1997. Ceanothus integerrimus. In: Fire effects information system. USDA Forest Service. Rocky Mountain Research Station, Fire Sciences Laboratory. [Internet]. (accessed 2014 Apr 15). Available from http://www.fs.fed.us/database/feis

7. Kauffman JB and Martin RE. 1991. Factors influencing the scarification and germination of three montane Sierra Nevada shrubs. Northwest Science. 65(4): 180-187.

8. Kruckeberg A. 1996. Gardening with native plants. Seattle: University of Washington Press

9. Luna, Tara 2008. Propagation protocol for production of container *Ceanothus velutinus* Dougl. ex Hook. plants (172 ml (10 cu in)); USDI NPS - Glacier National Park, West Glacier, Montana. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 16 May 2014). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

10. McDonald PM, Laurie WD and Hill R. 1998. Early growth characteristics of planted deerbrush and Greenleaf Manzanita seedlings in California. Res. Note PSW-RN-422. Albany (CA): USDA Forest Service, Pacific Southwest Research Station.

11. Reed MJ. 1974. Ceanothus L. ceanothus. In: Schopmeyer CS, technical coordinator. Seeds of woody plants in the United States. USDA Forest Service. Washington (DC): 284-290.

12. Strickler D. 1993. Wayside wildflowers of the Pacific northwest. Columbia Falls (MT): The Flower Press

13. Quick CR and Quick AS. 1961. Germination of ceanothus seeds. Madrrono. 16: 23-30.

14. USDA Natural Resources Conservation Service Plants Database.

	[Internet]. URL; http://www.plants.usda.gov [accessed 2014 Apr 7]. 15. Young JA and Young CG. 1992. Seeds of woody plants in North America. Portland (OR): Dioscorides Press.
Other Sources Consulted (but that contained no pertinent information):	Franklin JF and Dyrness CT. 1973. Natural vegetation of Oregon and Washington. Corvallis (OR): Oregon State University Press. Harper-Lore B and Wilson M (editors). 1999. Roadside use of native plants. Washington (DC): Island Press Rose R, Chachulski CEC and Haase DL. 1998. Propagation of Pacific northwest native plants. Corvallis (OR): Oregon State University Press. .
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