

Propagating Native Species: Experience at the Wind River Nursery

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ABSTRACT: *Propagation information developed at the USDA Forest Service Wind River Nursery in Carson, WA, is provided for 9 hardwood tree and 30 shrub species native to the Pacific Northwest. This includes information on: seed collection, extraction, stratification, and storage; timing of collection and propagation techniques for cuttings; and a summary of propagation experience (planting media and container used, specialized methods, and type of stock produced). Most species were propagated from seed, some from stem or root cuttings, and some from both seed and cuttings. Some species were very difficult or impossible to propagate at the nursery. West. J. Appl. For. 14(2):61-64.*

In the last 10 yr, there has been a major increase in interest in the use of native plants in forestry projects in the Pacific Northwest. These projects have been designed with restoration or rehabilitation goals, to produce timber with alternative native tree species (in pure or mixed stands), or to jointly produce wood and other values. Most tree nurseries have had experience growing only a few species (the major commercial conifers and those species used as ornamentals); thus, relatively little knowledge is available on how to propagate many native species. In addition, although many commercial nurseries have developed techniques for propagating some species, most of this information is not readily available to others.

The Wind River Nursery (WRN) at Carson, WA, was established by the USDA Forest Service in 1909, and for many years, most of its emphasis was on producing seedlings of native conifers for reforestation projects. In 1990, the Pacific Northwest Region of the USDA Forest Service decided to expand the scope of work at WRN to include propagation of native plants (trees, shrubs, herbs, and grasses). Some propagation work had been done over the years on nonconifers, but this decision to expand the scope of the nursery resulted in construction of new bed house and greenhouse facilities and assignment of personnel specifically to work on developing propagation methods for new species and producing plants for out planting. Much was learned about the propagation of many species

during the next few years. This work on native plants was halted with the closure of WRN in 1997.

This report summarizes the experience of the WRN with propagation of native hardwood trees and shrubs. The nursery was successful in determining useful propagation methods for several species and in determining general information on seed extraction and germination or vegetative propagation for many others. This information should supplement what is available from other sources on plant propagation (e.g., Dirr 1987, Gill and Kelly 1974, Rose et al. 1998, Schopmeyer 1974). Future work may discover methods which are more successful or better suited to large-scale production than those provided here; however, it is our hope that publication of this information will help others propagate these species without having to go through the same learning exercise.

Extraction

Seed extraction presents many challenges as the species represented package their seeds in different ways. Some are similar in appearance to *Pinus* or *Pseudotsuga* (winged, single seed), some have a large seed inside a hard shell, while others may have dozens of seeds in a dry capsule or a soft pulpy fruit (Table 1a). Extraction methods range from merely drying and shaking a seed pod or woody cone-like structure, to those that involve crushing fruits or mixing them in a blender to separate the seeds from the pulp, or that involve use of specialized separation equipment (Table 1a).

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Table 1a. Summary of experience in propagating hardwood tree (T) and woody shrub (S) species at WRN. Scientific names and fruit types are from Hitchcock et al. (1969).

Common name	Scientific name	Prop. meth.	Fruit type	Coll. time	Seed extr.	Strat.	S/R date	Loc.
Vine maple (S)	<i>Acer circinatum</i>	S	S	3	1,6	2	F	NB
Rocky Mt. maple (S)	<i>A. glabrum</i>	S	S	3	2	2	F	NB
Bigleaf maple (T)	<i>A. macrophyllum</i>	S	S	3	2	1	S	NB
Thinleaf alder (S)	<i>Alnus incana</i>	S	NL	3	2	1	S	NB
Red alder (T)	<i>A. rubra</i>	S	NL	3	2	1	S	NB
Sitka alder (S)	<i>A. sinuata</i>	S	NL	3	2	1	S	NB
Hairy manzanita (S)	<i>Arctostaphylos columbiana</i>	C	B	3	—	—	F	MC
Pinemat manzanita (S)	<i>A. nevadensis</i>	C	B	3	—	—	F	MC
Oregon grape (S)	<i>Berberis nervosa</i>	S	B	3	5	2	F	T
Water birch (S)	<i>Betula occidentalis</i>	S	S	3	2	1	S	NB
Paper birch (T)	<i>B. papyrifera</i>	S	S	3	2	1	S	NB
Redstem ceanothus (S)	<i>Ceanothus sanguineus</i>	S	Cps	3	3	2	S	NB
Pacific dogwood (T)	<i>Cornus nuttallii</i>	S	D	2,3	3*	2	F	NB
Red-osier dogwood (S)	<i>C. stolonifera</i>	S, C	D	2,3,4*	2	2	S	T,MC,NB
Hazel (S)	<i>Corylus cornuta</i>	S	N	2,3*	8	2	F	NB
Black hawthorn (S)	<i>Cretaegus douglasii</i>	S	B	3	3	3	F	NB
Oregon ash (T)	<i>Fraxinus latifolia</i>	S	S	3	8	2	F	NB
Salal (S)	<i>Gaultheria shallon</i>	S**	B	3	2	1	F	T
Ocean spray (S)	<i>Holodiscus discolor</i>	S	F	2	2	3	F	NB
Oregon crab apple (S)	<i>Malus fusca</i>	S	P	2,3	4	1	S	NB
Oregon boxwood (S)	<i>Pachistima myrsinifolia</i>	C	Cps	3**	—	—	F	MC
Penstemon (S)	<i>Penstemon</i> spp.	S, C	Cps	1,2	2	2	F	T,MC
Mock orange (S)	<i>Philadelphus lewisii</i>	S	Cps	2	2	2	S	T
Quaking aspen (T)	<i>Populus tremuloides</i>	R	Cps	3,4**	—	—	S	MC
Black cottonwood (T)	<i>P. trichocarpa</i>	C, S	Cps	1	7	1	S	T,F
Oregon white oak (T)	<i>Quercus garryana</i>	S	A	3	8	2	F	NB
Cascara (S)	<i>Rhamnus purshiana</i>	S	D	2,3*	5*	3	F	NB
Pacific rhododendron (S)	<i>Rhododendron macrophyllum</i>	S	Cps	3	2	1	S	T
	<i>Ribes</i> spp.	S	B	2	3	2, 3	S	T
	<i>Rosa gymnocarpa</i>	S	Cps	2,3	2	2	F	NB
	<i>Salix</i> spp.	C***	Cps	2**,3,4	—	—	—	—
	<i>Sambucus callicarpa</i>	U*	B	—	—	—	—	—
	<i>S. glauca</i>	U	B	—	—	—	—	—
	<i>Sorbus sitchensis</i>	S	P	2,3	3,6	2	F	NB
	<i>Symporicarpos albus</i>	S, C	B	3,4	3	3	F	MC,NB
	<i>Vaccinium alaskaense</i>	S	B	2	5*	1	S	T
	<i>V. mambranaceum</i>	S	B	2	5*	1	S	T
	<i>V. ovalifolium</i>	S	B	2	5*	1	S	T
	<i>V. parvifolium</i>	S	B	2	5*	3	F	T

Propagation method: C = Stem cutting; R = Root sucker; S = Seed; U = WRN unable to propagate (* = limited success with early fall seed sow; ** = other nurseries have used cuttings. *** = other nurseries have used seed).

Fruit/Seed types: A = Acorn; B = Berry; Cps = Capsule; D = Drupe; F = Follicle; N = Nut; NL = Nutlet; P = Pome; S = Samara.

Seed or cutting collection time: 1 = Spring; 2 = Summer; 3 = Fall; 4 = Winter. (* = Collect early to avoid seed/fruit loss; ** = Timing for stem cutting)

Seed extraction: 1 = Crack pericarp with roller after 5 day soak; 2 = Dry fruit/cone and break apart by hand; 3 = Dry fruit, use rubbing board to separate seeds from pulp and rinds (* = sowed without defleshing); 4 = Separate seeds from fresh fruit by hand; 5 = Mash fresh fruit (or rehydrated dry fruit) with water and separate (* = blender used); 6 = Many empty or partially filled seeds, try gravity table, water float, or air separation; 7 = Use air to force seed through a set of screens; 8 = None.

Stratification: 1 = Short, cool; 2 = Long, cool; 3 = Warm/Cool cycle.

Sow date or rooting date: S = Spring; F = Fall.

Sowing/planting locations: T = Tray; MC = Mist chamber; NB = Nursery bed; F = Field.

WRN extracted seed for several species with the aid of a rubbing board. Fruits are allowed to air-dry, then placed on a board that is covered with a ribbed rubber mat. The fruits are rubbed against the board using a small "paddle" faced with the same material. The seeds tend to stay in the mat's grooves, and lighter material can be brushed or blown off of the board. The board has wooden sides that can be adjusted in height to hold seed material. Some seed is lost or broken, but when large amounts are needed, this

extraction method allows relatively few people to extract the seed in a short period of time. This method is especially effective for redstem ceanothus.

Germination and Plant Growth

Detailed information on the stratification requirements for germination is not available for most species; however, the general requirements for seed germination have been

determined (Table 1a and 1b). If past experience has indicated that a cool, moist stratification period is required, germination rates are relatively high, and large amounts of seed are to be sown, fall sowing in the nursery has been the most common practice. For some very palatable species, however, fall sowing can result in losses due to seed predation (see section on animal damage below).

For species with low germination, particularly if the plants will be grown for more than one year, the nursery has sown the seeds in flats and transplanted the germinants. The flats or trays were filled with moist perlite plus up to 20% peat moss for moisture retention, seeds were broadcast on the surface, and additional perlite was added to cover the seeds. The flats were covered with glass or plexiglas to reduce moisture loss but allow

Table 1b. Summary of experience in propagating hardwood tree (T) and woody shrub (S) species at WRN. Scientific names are from Hitchcock et al. (1969).

Common name	Scientific name	Cont.	Media	Other treatments		Stock types	Seed storage	
				Des. size	Cond.		Time	
Vine maple (S)	<i>Acer circinatum</i>	—	4	—	2	1	1	<2
Rocky Mt. maple (S)	<i>A. glabrum</i>	—	4	—	1	1	1	<2
Bigleaf maple (T)	<i>A. macrophyllum</i>	—	4	—	1*	1	1	<2
Thinleaf alder (S)	<i>Alnus incana</i>	—	4	—	1,2,7	1,2	1	5-7
Red alder (T)	<i>A. rubra</i>	—	4	—	1,2,7	1,2	1	5-7
Sitka alder (S)	<i>A. sinuata</i>	—	4	—	1,2,7	1,2	1	5-7
Hairy manzanita (S)	<i>Arctostaphylos columbiana</i>	MP	1,3	1	1,2	2	—	—
Pinemat manzanita (S)	<i>A. nevadensis</i>	MP	1,3	1	1,2	2	—	—
Oregon grape (S)	<i>Berberis nervosa</i>	SP	1,3	14	2	2	—	—
Water birch (S)	<i>Betula occidentalis</i>	—	4	—	1,7	1	1	5-7*
Paper birch (T)	<i>B. papyrifera</i>	—	4	—	1,7	1	1	5-7*
Redstem ceanothus (S)	<i>Ceanothus sanguineus</i>	—	4	5	1,7	1	1	5-7
Pacific dogwood (T)	<i>Cornus nuttallii</i>	—	4	—	1,2*	1	1	5-7*
Red-osier dogwood (S)	<i>C. stolonifera</i>	—	1,4	10,11	1,2,7	1,3,4	1	5-7
Hazel (S)	<i>Corylus cornuta</i>	—	4	6	1	1	1	0
Black hawthorn (S)	<i>Craetaegus douglasii</i>	—	4	—	1,7	1	1	5-7*
Oregon ash (T)	<i>Fraxinus latifolia</i>	—	4	—	1,2,7	1	1	unk.
Salal (S)	<i>Gaultheria shallon</i>	LC	1,2	—	1-4	1,2	1	3-4*
Ocean spray (S)	<i>Holodiscus discolor</i>	—	4	6,7	1,2,7	1	1	3-4*
Oregon crab apple (S)	<i>Malus fusca</i>	—	4	—	1	1	—	unk.
Oregon boxwood (S)	<i>Pachistima myrsinifolia</i>	SP	1,3	1	1,7	2	—	—
Penstemon (S)	<i>Penstemon</i> spp.	SP,MP	1,3	—	1,4	2	—	3-4*
Mock orange (S)	<i>Philadelphus lewisii</i>	SP	2,3	—	1,2,7	1,2	1	3-4*
Quaking aspen (T)	<i>Populus tremuloides</i>	MP	1,3	1,10	1,2	1,2	1	—
Black cottonwood (T)	<i>P. trichocarpa</i>	SS,TP	2,3,4	3,11	1,5,6	1-4	1	—
Oregon white oak (T)	<i>Quercus garryana</i>	—	4	2,9	1,7	1	1	0
Cascara (S)	<i>Rhamnus purshiana</i>	—	4	—	1,2,7	1	1	3-4*
Pacific rhododendron (S)	<i>Rhododendron macrophyllum</i>	SP,LP	2,3	4,15	2,3	2	—	3-4*
Currant (S)	<i>Ribes</i> spp.	SP,MP	2,3	—	2,3	2	—	3-4*
Baldhip rose (S)	<i>Rosa gymnocarpa</i>	—	4	—	1,7	1,2	1	3-4*
Willow (T)	<i>Salix</i> spp.	SC,TP	2,3	11	1,5,7	1,3,4	1,2	—
Red elderberry (S)	<i>Sambucus callicarpa</i>	—	—	—	—	—	—	—
Blue elderberry (S)	<i>S. glauca</i>	—	—	—	—	—	—	—
Sitka mountain ash (S)	<i>Sorbus sitchensis</i>	—	4	8	1,2,7	1	1	3-4*
Snowberry (S)	<i>Symporicarpus albus</i>	SC,LC	1,2,4	10,12	1,2,7	1,2	1	3-4*
Alaska huckleberry (S)	<i>Vaccinium alaskaense</i>	SP	1,2,3	4,13,15	2,3	1,2	2	2-3*
Big huckleberry (S)	<i>V. mambranaceum</i>	SP	1,2,3	4,13,15	2,3	1,2	2	2-3*
Oval-leaf huckleberry (S)	<i>V. ovalifolium</i>	SP	1,2,3	4,13,15	2,3	1,2	2	2-3*
Red huckleberry (S)	<i>V. parvifolium</i>	SP	1,2,3	4,13,15	2,3	1,2	2	2-3*

Containers: SC = Small cavity block; LC = Large cavity block; SS = "Supercell"; TP = Tall pot; SP = 10-15 cm pot; MP = up to 7.6 l pot; LP = >7.6 l pot.

Planting/rooting media: 1 = Perlite (germination or rooting only); 2 = Perlite/vermiculite/peat moss mixture; 3 = Perlite/vermiculite/barkdust mixture; 4 = mineral soil.

Other treatments: 1 = Heated rooting zone for cuttings; 2 = Undercut roots; 3 = Irrigate from below; 4 = Inoculate with mycorrhizae (chop roots, soak for 24 hr, apply to new cuttings); 5 = Hot water seed treatment (Schopmeyer, 1974); 6 = Store early-picked seeds in refrigerator to after-ripen, keep seeds moist during germination; 7 = Cover seed with mulch cloth in fall; 8 = Early fall sowing is best; 9 = Soak seeds 12-24 hr before sowing; 10 = Dip in rooting hormone, root in mist chamber; 11 = Soak unrooted cuttings in water for 5 days before planting; 12 = Withhold water to prepare for fall planting; 13 = Do not heat rooting zone; 14 = Transplant germinants, repeat cool stratification of flat, regerminate; 15 = Grows well under shade cloth.

Desired sizes: 1 = 1-0; 2 = 2-0; 3 = 3-0; 4 = 30 cm cutting; 5 = cutting; 6 = whip; 7 = 1-1 or plug-1.

Stock types: 1 = Bareroot seedling; 2 = Container seedling; 3 = Standard cuttings; 4 = Whip cuttings. (* = Prone to top damage when seedlings are left in NB over the fall/winter)

Seed storage conditions: 1 = Refrigerated, dry; 2 = Frozen, dry.

Seed storage time (yr): * = Estimated storage time, not yet tested.

light to promote germination. The flats were placed in a cooler, a large refrigerator, or an unheated greenhouse to provide cool, moist stratification. When stratification is complete, the flats can be transferred to a heated greenhouse for germination without having to transfer the seeds to another container. This method works very well for producing huckleberry seedlings. Well-established seedlings can be hand transplanted to individual containers for varying lengths of time (depending on seedling growth rates and desired size for planting). At WRN, these containers ranged from styro-block cavities to 10 cm × 10 cm (or even larger) pots. Moss and/or weed control was limited in the flats but more extensive in the containers. See Table 1b for specialized treatments and types of media and containers used.

After a year or more in containers, most seedlings were ready to transplant into nursery beds or to take directly to the planting site. If held over in the nursery bed, they received various standard treatments (fertilizer, irrigation, root-wrenching, etc.) as required for their purpose (field planting or as cutting stock).

Vegetative Propagation

Some plants were propagated from cuttings, either directly in the field or at the nursery. If bare-root stock was desired from species with slow growth rates, the cuttings were usually rooted in small containers, grown for a season or two, then transplanted to the field. Species such as black cottonwood, red-osier dogwood, and willow can be propagated as rooted or unrooted cuttings. Although rooted cuttings are more expensive to produce, some managers prefer to use them on their more severe planting sites (droughty soils, well-established competing vegetation, or high herbivory expected) to increase the likelihood of successful establishment. If unrooted cuttings were to be planted, the cuttings were often collected months ahead of time, then stored until spring; these stored cuttings were soaked for 5 days before planting to increase the speed of root production. If rooted cuttings are desired, the material should also be soaked prior to beginning the rooting process. Quaking aspen can easily be propagated using suckers produced from root cuttings; the cleaned pieces of root are placed in trays filled with peat moss or vermiculite and covered with 1 to 2 cm of the same material, and the tray is placed in a growth chamber or mist bed. The suckers are harvested when they are 5 to 20 cm long, dipped in a rooting hormone, and placed in a mist chamber with a heated rooting zone to promote rapid root extension (see comments in Table 1b for other species). Oregon boxwood and manzanita cuttings also benefit from a heated rooting zone.

In addition to collecting cuttings from natural vegetation, there are other techniques that can be more efficient when large

numbers of cuttings are required or when access to an area is limited during the time period when the cuttings need to be collected. The most common high-yield method is the traditional stool bed, which WRN has established for black cottonwood and willows from several sources. A stool bed (sometimes called a coppice bed) is created by planting at a reasonable spacing for the species (up to about 3 m × 3 m) and repeatedly cutting the resulting shoots from the rootstock; this produces very uniform cuttings. Rootstocks can last for many years and are easily replaced with some of their own cuttings.

Another way to increase cutting production is known as the "Miller bow technique" (named for Rob Miller of Mt. Jefferson Farms in Salem, OR). Cuttings are planted in beds several meters apart; when the base diameter is 10 to 12 cm, the stem is partially girdled/undercut near the base and bent over on its side. Sprouts are produced from the root collar as well as from the rest of the tree. This method has been used by WRN with cottonwood and willow to produce both tall whips (some up to 3 or 4 m tall) and regular-size cuttings. After leaf fall, the current year's growth is pruned, and the plant produces another crop the next spring.

Animal Damage

Seed predation and animal browsing, rubbing, or gnawing have been problems at WRN, as many of these plant species are very palatable to several wildlife species. Deer and elk frequently browse new growth in nursery beds, and many rodents and birds eat seeds and germinants in both nursery beds and greenhouses. The WRN has used various control methods, including snap or live traps, barriers (including fencing), and repellants. Fencing at a height of 2.5 m or higher was found to be the most effective method to prevent browsing by large animals. The need for active control measures should be actively monitored as major losses can occur in a short time period.

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