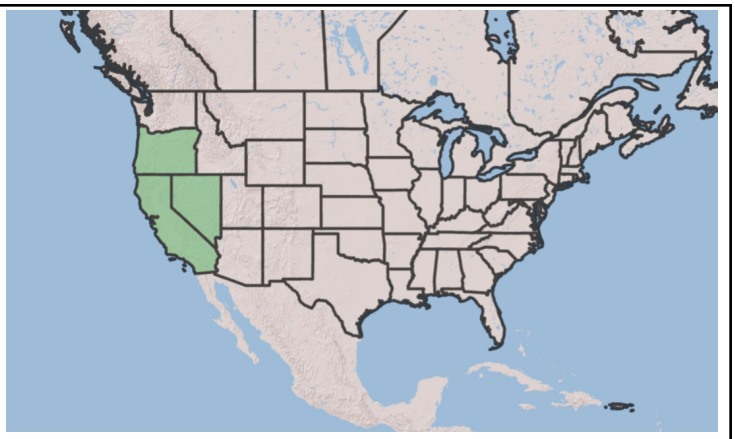
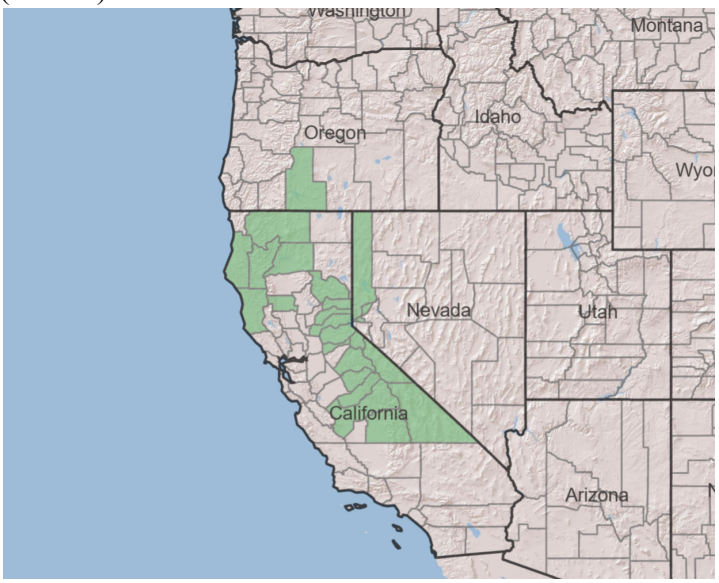
Plant Propagation Protocol for *Sorbus californica*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/2022/SOCA8.pdf

(Below)

TAXONOMY	
Plant Family	
Scientific Name	Rosaceae
Common Name	Rose
Species Scientific Name	
Scientific Name	Genus: *Sorbus* Species: *californica* Species Authority: Edward Lee Greene
Varieties	None
Sub-species	None
Cultivar	None
Common Synonym(s)	None
Common Name(s)	California Mountain Ash
Species Code (as per USDA Plants database)	SOCA8 (USDA)
GENERAL INFORMATION	

Geographical range	 (USDA)  (USDA)
Ecological distribution	Plant occurs in moist conifer forests (Zika) in forest clearings at mid to high elevations (Alves).
Climate and elevation range	Preferred elevation is 1200 - 4300 meters (Zika). Preferred climate unknown.
Local habitat and abundance	Plant is found in some parts of California, southern Oregon, and western Nevada (Zika). Grows in yellow pine forest, mixed evergreen forests, red fir forests, lodgepole forests, and subalpine forests (Alves).
Plant strategy type / successional stage	Plant adapts to many soil types as long as it is moist. Plant is intolerant of fire, drought, and shade and requires some winter chill to bloom (Alves). Plant's fruit also serves as a food source for birds, who in turn spread the seeds (Alves). Plant flowers from May to June (Zika).
Plant characteristics	Plant is a perennial shrub (USDA) and grows 1-3 meters tall (Zika). Plant has deciduous pinnately compound leaves with 7-9 leaflets. Leaflets are 2-5 cm

	long and 1-2.5 cm wide. Leaflets are shiny, and they are dark green above and paler beneath with some serration. Leaflets are oblong to ovate shaped. Flowers are small with round petals 3-4 mm wide. Inflorescences contain 15-80 flowers. Fruit is round, bright red, and 6-12 mm across. Fruit resembles small apples and comes in clusters (Alves); (Zika).  View of leaves and of a cluster of flowers (Matson).  Close up view of an individual flower (Matson).

Flowers in the process of blooming, not yet fully open. (Matson)

Fruit cluster (Matson).

PROPAGATION DETAILS

Plant Propagation Principles and Practices: Propagation of Ornamental Trees, Shrubs, and Woody Vines

(Davies et al. 820-902) Propagation of Genus Sorbus, not species specific	
Ecotype	No information provided.
Propagation Goal	No information provided.
Propagation Method	Seed
Product Type	Seeds
Stock Type	No information provided.
Time to Grow	No information provided.
Target Specifications	No information provided.
Propagule Collection Instructions	Seeds should be collected as soon as the fruits mature.
Propagule Processing/Propagule Characteristics	No information provided.
Pre-Planting Propagule Treatments	Remove fleshy parts of fruit to eliminate inhibitors. Seed is usually cold stratified at 1-4°C (34-40°F) with the best germination occurring at the cold stratification temperatures. Germination at these temperatures can take up to 4 months. For some species, a period of 3-5-month warm dry storage prior to the cold stratification/germination period can shorten the germination time. Exposing stratified seeds to warm germination temperatures above 25°C (77°F) can induce secondary dormancy.
Growing Area Preparation / Annual Practices for Perennial Crops	No information provided.
Establishment Phase Details	No information provided.
Length of Establishment Phase	No information provided.
Active Growth Phase	No information provided.
Length of Active Growth Phase	No information provided.
Hardening Phase	No information provided.
Length of Hardening Phase	No information provided.
Harvesting, Storage and Shipping	No information provided.
Length of Storage	No information provided.
Guidelines for Outplanting / Performance on Typical Sites	No information provided.
Other Comments	None.
PROPAGATION DETAILS Propagation Protocol Information of *Sorbus scopulina* Green (Trindle and Flessner) This information is included because *Sorbus scopulina* is also commonly called mountain ash and has similar morphology to *Sorbus californica.*	
Ecotype	Crater Lake National Park, OR. Gathered at 6,500 ft. elevation; mostly occurring in a few dense stands near headquarters buildings; not widely distributed in the Park.

Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container (plug)
Stock Type	1 gallon containers
Time to Grow	2 years
Target Specifications	Large healthy, 2-year crown foliage; roots filling soil profile.
Propagule Collection Instructions	Ripe berries in large clusters easily identified and collected in September and transported in plastic bags in cooler.
Propagule Processing/Propagule Characteristics	Berries should be depulped as soon as possible because pulp contains germination inhibitors. Depulp in blender with rubber tubing covering blender blades; wash and float off pulp/juice several times to remove all traces of fruit pulp prior to straining and air-drying on paper toweling. Seed reportedly stores well for several years in sealed containers at 6 to 8% moisture content.
Pre-Planting Propagule Treatments	60 days cold-moist stratification given as a minimum in literature; seed lots performed much better after 16 weeks (112 days) of cold-moist stratification. 1 year old seed yielded 61% germination with excellent vigor. while a 3 year old seed lot had 25% germination and fairly good vigor.
Growing Area Preparation / Annual Practices for Perennial Crops	Seedlings were stratified directly in a peat-based potting mix in standard 10 inch x 20 inch flats, watered in and sealed in polyethylene bags in a walk-in cooler at ~1 to 3°C (~34 to 38°F); stratified flats taken to a greenhouse bench at moderate temps in spring to germinate
Establishment Phase Details	Seedlings emerged quickly. Germination was complete for both 1 and 3 year old seeds after 21 days; from then seedlings grew quickly and were ready to transplant directly into 1 gallon containers after a few weeks.
Length of Establishment Phase	6 weeks
Active Growth Phase	Seedlings were potted up into 1-gallon ribbed containers with a rich greenhouse soil mix of peat/perlite/organic "Black Gold" soil mix amended with low rates of Osmocote slow release fertilizer and Micromax trace elements. Seedlings survived transplanting well and were given one dose of Peters' seedling starter fertilizer (9-45-15 NPK) about 2 weeks after transplanting. Pots were kept in the greenhouse until late May when they were moved outdoors to a shade-house on raised benches and provided with drip

	irrigation. During late May/July plants were fertilized every other week with half-strength Peters' Triple 20 NPK fertilizer.
Length of Active Growth Phase	May-August
Hardening Phase	Fertilizer discontinued in July; watering intervals gradually lengthened, and shade cloth removed at end of August to allow full sun acclimation.
Length of Hardening Phase	August-September
Harvesting, Storage and Shipping	1st-year plants held outdoors in lathhouse over winter at Corvallis, OR, and returned to the shadehouse in April for the second season. Plants were shipped to Crater Lake in August of the 2nd year via refrigerated van to a holding facility at the park for a few weeks of acclimation prior to outplanting.
Length of Storage	No information provided.
Guidelines for Outplanting / Performance on Typical Sites	Roots should be scored at outplanting time in late September. Plants survived well in the lodge restoration planting at the Park.
Other Comments	This accession was not keyed out to subspecies; not determined whether it is subspecies sitchensis. Summer softwood cuttings with 1 year old wood "heels" were also tried at Corvallis, OR, with moderate success; however seed propagation was much more efficient for this species.

PROPAGATION DETAILS

Sorbus scopulina Protocol Information

USDA Forest Service Reforestation, Nurseries, and Genetic Resources Center (Justin and Zeidler)

This information is included because *Sorbus scopulina* is also commonly called mountain ash and has similar morphology to *Sorbus californica.*

Ecotype	Utah
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Bareroot (field grown)
Stock Type	2+0
Time to Grow	2 Years
Target Specifications	Height: 12 in Root System: root system must balance top growth
Propagule Collection Instructions	Seeds are wild collected during fall months and are kept separated according to site, elevation and source. Mature fruit is an orange pome containing several seeds.
Propagule Processing/Propagule Characteristics	No information provided.

Pre-Planting Propagule Treatments	Seeds are cleaned prior to storage and kept in air tight containers in a seed storage room at temperatures below freezing.
Growing Area Preparation / Annual Practices for Perennial Crops	Seeds planted in the fall in a thin layer of sand on mulched field beds. Soils: field soils are Taylorsville Sandy clay loam with Cca horizon shallower than 12 inch, Taylorsville sand clay loam variant with Cca deeper than 12 in,ch Taylorsville Clay loam variant with Cca horizon shallower than 12 inch and Taylorsville Clay loam variant with Cca horizon deeper than 12 inch. Field Bed Preparation: beds are marked out and formed as needed. 0-45-0 (N:P:K) is applied in April. 2 to 3 inches of compost are applied to seed beds prior to sowing. Sulfur is applied during May. Fields are cultivated for weeds as needed throughout the growing season. Irrigation: overhead irrigation is used. There is a 2 inch aluminum pipe that can be moved from field to field each year. Our principle water source is from a canyon stream to the north of here and is very good quality water.
Establishment Phase Details	Seeds are sown in late September using an Oyjard seed drill at a depth of 0.12 inches. Seeds are lightly covered and irrigated when soils appear to be drying out on warm days. Desired field density is 18 trees per square foot.
Length of Establishment Phase	1 month after emergence in the spring.
Active Growth Phase	Year 1 Fertilization: Morgro 21-0-0 (N:P:K) is applied with the Gandy spreader (setting 18, speed 2 mph, rpm 1100 to 1200) the second week of each month during the growing season from April to August. Fertilizer is applied at the rate of 120 lbs/acre. At least 45 minutes of irrigation follows all fertilizer applications. This insures that foliage will not burn and incorporates fertilizer into the root zone. Fertilizer is not applied when foliage is wet. All sulfur and 0-45-0 (N:P:K) applications must be mechanically incorporated since these amendments are not mobile in the soil. Year 2 2+0 nursery stock is fertilized the second year using the Herd Spreader, since stock is usually too tall the second year to use the Gandy spreader. Root Pruning Procedures

	Deciduous species are pruned when they are 10 to 12 inches tall. Irrigate heavily for 2 to 3 days prior to pruning to saturate the root zone. Set pruning blade to slightly wrench seedlings as they are pruned. Check pruning depth frequently and adjust as needed. Irrigate for a minimum of 2 hours following root pruning to settle soil back around roots. This step is critical to eliminate post root pruning mortality. Irrigate field heavily for 2 to 3 days to further settle the soil. Top pruning is typically done with sickle bar mower attached to the 656. Operational speed varies, but is not done above 1200 rpm. Cut at the desired height; constantly checking and adjusted the cut during the process. Keep field workers behind the cutting head.
Length of Active Growth Phase	4 months
Hardening Phase	Hardening begins during the third week of August or when dormancy is induced. No fertilizer is applied after August 28th. Irrigation frequency and duration is shortened and applied only when needed.
Length of Hardening Phase	2 months
Harvesting, Storage and Shipping	Lifting window is during mid November of the second year when seedlings are completely dormant. Seedlings are hand lifted after the seedling beds have been undercut at a depth of 10 or 12 inches using a lifter. Fall lifted seedlings are "heeled in" in sandy soils after we have graded and bundled them in bundles of 25. They are lifted in spring before they break dormancy then stored in our cooler on stacked pallets. Lifted seedlings are kept in a cooler at between 2 to 5.5°C (36 to 42°F) and at a relative humidity of 92 to 98% with good air circulation.
Length of Storage	No information provided.
Guidelines for Outplanting / Performance on Typical Sites	No information provided.
Other Comments	None.

PROPAGATION DETAILS

Sorbus scopulina Protocol Information

USDA Forest Service Reforestation, Nurseries, and Genetic Resources Center (Luna and Wick)

This information is included because *Sorbus scopulina* is also commonly called mountain ash and has similar morphology to *Sorbus californica.*

Ecotype	Two Medicine, Glacier National Park, MT. 1585 meters elevation.
Propagation Goal	Plants
Propagation Method	Seed

Product Type	Container (plug)
Stock Type	172 ml containers
Time to Grow	10 months
Target Specifications	Stock Type: Container seedling Height: 9 cm Caliper: 8 mm Root System: firm plug in Conetainer.
Propagule Collection Instructions	Seeds are hand collected when fruit turns red-orange in early October. Seeds are brown at maturity. Fruit is collected in plastic bags and kept under refrigeration prior to cleaning. Collection location: Two Medicine and Cutbank Campgrounds, Glacier National Park, MT.
Propagule Processing/Propagule Characteristics	Seed Longevity: up to 5 years at 3 to 5°C with low relative humidity in sealed containers. Seed dormancy is classified as physiological dormancy. Seed Density Seeds/Kg: 100,000/kg % Purity: 100% % Germination: 90 to 100%
Pre-Planting Propagule Treatments	Seeds are extracted from fruit by maceration using a Dyb-vig seed cleaner and are washed and screened to remove pulp from the seeds. Seeds are treated with 1,000 ppm gibberellic acid for 24 hours, followed by a 3:1 water/hydrogen peroxide soak for 10 minutes, and a 24 hour running water rinse. A 90 to 120 day cold, moist stratification is needed to break dormancy. Seeds are placed in fine mesh bags and buried in moistened peat moss in ventilated containers under refrigeration at 1 to 3°C
Growing Area Preparation / Annual Practices for Perennial Crops	Greenhouse and outdoor nursery growing facility. Sowing Method: direct seeding or planting germinants. Seeds are covered with medium. Growing medium used is 6:1:1 milled sphagnum peat, perlite, and vermiculite with Osmocote controlled release fertilizer (13N:13P2O5:13K2O; 8 to 9 month release rate at 21°C) 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 Conetainer. Greenhouse temperatures are maintained at 21 to 25°C during the day and 16 to 18°C at night. Seedlings are hand watered and remain in greenhouse until mid May. Seedlings are then moved to outdoor nursery for the remainder of the growing season. Seedlings are

	irrigated with Rainbird automatic irrigation system in early morning until containers are thoroughly leached.
Establishment Phase Details	Germination occurs at 22°C and is usually complete in 20 days. Cotyledon to true leaf stage is 2 weeks. Seedlings are thinned at this stage.
Length of Establishment Phase	4 weeks
Active Growth Phase	Seedling growth is rapid following germination. Plants are fertilized with 20-10-20 liquid NPK at 100 ppm and increase in height to 9 centimeters in 10 weeks. Root development occurs at a rapid rate and seedlings must be up-potted to 1 gallon containers the 1st season if they are not outplanted by fall.
Length of Active Growth Phase	16 weeks
Hardening Phase	Plants are fertilized with 10-20-20 liquid NPK at 200 ppm during August and September. Irrigation is gradually reduced in August and September. Pots are leached with clear water before winterization.
Length of Hardening Phase	4 weeks
Harvesting, Storage and Shipping	Total Time to Harvest: 10 months Harvest Date: September Storage Conditions: Overwinter in outdoor nursery under insulating foam and snow.
Length of Storage	5 months
Guidelines for Outplanting / Performance on Typical Sites	No information provided.
Other Comments	Seed propagated material grows rapidly. First year seedlings in 3 L (1 gallon) containers were 15 cm tall with 2.0 cm caliper. Plants reach reproductive maturity in 3 to 5 years. There are 2 botanical varieties: *scopulina*, and *cascadensis*. *S. scopulina* is an important browse for bears, deer, moose and elk. The berries are eaten by many species of birds and small mammals. Bears feed on berries in late fall.

PROPAGATION DETAILS

Sorbus scopulina Protocol Information

USDA Forest Service Reforestation, Nurseries, and Genetic Resources Center (Luna and Hosokawa)

This information is included because *Sorbus scopulina* is also commonly called mountain ash and has similar morphology to *Sorbus californica.*

Ecotype	Two Medicine, Glacier National Park, MT. 1585 meters elevation.
Propagation Goal	Plants
Propagation Method	Vegetative
Product Type	Container (plug)

Stock Type	800 mL containers
Time to Grow	17 months
Target Specifications	Stock Type: Container cutting Height: 30 cm Caliper: 1.0 cm Root System: firm plug in container
Propagule Collection Instructions	Vegetative Propagation Method: Pre-Rooting Type of Cutting: late summer semi-hardwood stem cutting collected in early August. Cuttings were taken from nonflowering stem tip shoots.
Propagule Processing/Propagule Characteristics	No information provided.
Pre-Planting Propagule Treatments	Cuttings are kept moist and under refrigeration prior to pre treatment. Semi-hardwood tip cuttings were 15 to 25 cm in length and 0.3 to 1.3 cm in diameter. Cuttings were treated with 4000 ppm Hormex rooting powder and placed in 1:1 (v:v) sand and perlite medium in a mist bed with bottom heat. Rooting %: 47% after 6 weeks in mistbed. Cuttings with stem caliper of 9 mm to 1.2 cm rooted. Cuttings with smaller stem calipers failed to root. Time to Transplant: 6 weeks. Cuttings overwintered in mist bed and were potted the following spring.
Growing Area Preparation / Annual Practices for Perennial Crops	The outdoor mist bed has automatic intermittent mist that is applied at 6 second intervals every 6 minutes. Too frequent misting will result in leaf and stem rot. Misting frequency is increased or decreased according to daily outdoor temperature and wind. Bottom heat is maintained at 21°C with heating cables 12 cm beneath rooting medium. Mistbed is covered with shade cloth during rooting. After cuttings are potted, they are moved to an outdoor shadehouse for 4 weeks. They are later moved to full sun exposure in the outdoor nursery and are irrigated with Rainbird automatic irrigation system in early morning until containers are thoroughly leached. Average growing season of nursery is from late April after snowmelt until October 15th.
Establishment Phase Details	After lifting from the mistbed the following spring, cuttings were up-potted into 800 ml containers.
Length of Establishment Phase	4 weeks
Active Growth Phase	Plants are fertilized with 20-10-20 liquid NPK at 100 ppm during the active growth phase.
Length of Active Growth Phase	16 weeks

Hardening Phase	Cuttings overwinter in mistbed the first year. Plants are outplanted the second year.
Length of Hardening Phase	4 weeks
Harvesting, Storage and Shipping	Total Time To Harvest: 1.5 years estimated from cuttings Harvest Date: September Storage Conditions: Overwinter in outdoor nursery under insulating foam and snow.
Length of Storage	5 months
Guidelines for Outplanting / Performance on Typical Sites	*S. scopulina* inhabits well drained soils along streams, avalanche chutes and rocky hillsides.
Other Comments	There are 2 botanical varieties: *scopulina*, and *cascadensis*. Berries are an important food source in fall to many species of migrating songbirds and bears and small mammals.
INFORMATION SOURCES	
References	Alves, Ronald L. "Native Tree, Shrub, and Herbaceous Plant Identification." *Modesto Junior College*, 2014, https://www.mjc.edu/instruction/agens/images/native_plant_id.pdf. Below, Matt. "Sorbus Californica; California Mountain Ash." *Cal Photos*, UC Berkeley, 2006, https://calphotos.berkeley.edu/cgi/img_query?enlarge=0000%2B0000%2B0706%2B0531. Davies, Fred T., et al. "Propagation of Ornamental Trees, Shrubs, and Woody Vines." *Plant Propagation: Principles and Practices*, Pearson, New York, New York, 2018, pp. 820–902. IPNI. " Greene, Edward Lee (1843-1915)." *International Plant Names Index*, https://www.ipni.org/a/3366-1. Justin, John, and Scott Zeidler. "Sorbus (Scopulina) Protocol Information." *RNGR: Reforestation, Nurseries, and Genetic Resources*, USDA Forest Service, 2003, https://rngr.net/renderNPNProtocolDetails?selectedProtocolIds=rosaceae-sorbus-2681. Luna, Tara, and Dale Wick. "Sorbus (Scopulina) Protocol Information." *RNGR: Reforestation, Nurseries, and Genetic Resources*, USDA Forest

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Date Protocol Created or Updated	05/24/22