



EXTRACTION AND GERMINATION OF PACIFIC MADRONE SEED

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Abstract

Pacific madrone (*Arbutus menziesii*) seeds can be extracted and cleaned in a procedure which utilizes a mortar and pestle, a blender with a rubber blade, and several sieves. The method involves several steps but is not difficult and can result in a large amount of seed in a short period of time. Following extraction, the seeds can be dried and stored at low moisture content (6%) in sealed containers at 3-5°C or given a cold stratification treatment and then sown. Cold stratification periods of 60 days or longer increased the initial rate of germination compared to seeds stratified for 40 days but resulted in seed losses due to premature germination during stratification. For lots from the Puget Sound Lowlands, cold stratification for 40 days is adequate; seeds in stratification longer than 40 days should be monitored closely for premature germination.

Keywords

Arbutus menziesii, stratification

Introduction

Pacific madrone (*Arbutus menziesii*) is a widely-distributed native tree on the Pacific Coast from southern California north to southern British Columbia. Madrone wood is used for a range of products including specialty crafts, furniture, flooring, veneer, charcoal, and firewood; however, overall utilization is limited. The species is an important component of several forest types (McDonald and Tappeiner 1990) and is most common on drier sites, particularly on south aspects (McDonald et al. 1983). Madrone berries are an important food source for many species of wildlife because they are produced in large quantities and may persist on the tree for several months during the winter when alternative food sources are limited. Madrone foliage is evergreen and is also utilized as a food source by herbivores (especially deer and elk). Because management of the species has been almost non-existent, very

little attention has been paid to how to regenerate it for use in restoration or reforestation projects.

This report summarizes some basic information on madrone fruits and seeds, describes a method for seed extraction, and presents information on seed stratification and storage which should help future growers of the species.

Biological Description

The fruits are berries with bright orange or red skins. The berry skins are fairly thick and rough (*Arbutus* came from the Celtic word “arboise” meaning rough fruit, Roy 1974) and do not separate easily from the rest of the fruit. Berry size varies among and within trees and is not a good predictor of number of seeds per berry; however, very small berries (less than 5 mm diam) have few seeds and should be discarded. The mealy flesh has 4 to 6 cells, each with 4 to 6 hard, angled seeds. On average there are 15 to 25 seeds per berry (range of 7 to 44 based on examination of berries from 10 lots). The cells are surrounded with a suberized, fingernail-like material which varies among lots as to its thickness; when the cell-covering material is thick it does not break easily and thus can not be separated from the seeds by sieving.

Seed Extraction

Madrone berries can be easily collected and some people have tried to avoid the problem of seed extraction by just using a whole berry as the

seed packet; that can be successful in a backyard garden project where a low success rate is acceptable. However, using whole berries is not practical in a larger operation as use of intact berries often results in fungal problems (McDonald 1978), and if multiple seeds germinate the extra germinants must be thinned by hand. This report presents a method for extracting and cleaning madrone seed; it is a multi-step process but is simple to use, and the resulting seed is very clean. Seed losses during extraction are < 5% and most of those are empty or small seeds. The process uses a blender; blender extraction methods are not new and in fact a blender was suggested for use in cleaning seed of Texas madrone (Nokes 1986). However, it took several attempts to figure out how to go from using a blender to separate the seeds from the pulp and the skins, to developing an efficient process that results in clean seed and we hope others can benefit from our experience. Pulp and seed characteristics vary among berry lots due to genetic or environmental differences, ripeness of berries, or degree of drying between collection and extraction. Steps outlined below should be modified and experimented with to fit your needs (i.e., soaking time, collection from sieve techniques, sorting techniques).

Recommended Extraction Method

Blender Modification

A household blender was modified by replacing the metal blade with a rubber one. The rubber blade was attached to the blender rotor with the screw

system that had originally affixed the metal blade. The rubber blade was cut from a ball flush valve diaphragm (designed for use in a toilet). It was cut to approximately the same size as the original metal blade in the blender. Replacement of the blender manufacturer’s blade with a rubber substitute can create two potential hazards: the screw may come loose, or the blade could disintegrate. We suggest careful attention when removing or replacing the blade-holding hardware (screw) to avoid stripping it. We also suggest: (1) pressing down on the top of the blender during operation, (2) wearing safety glasses while the machine is running, and (3), inspecting the screw regularly for signs of loosening.

Seed Extraction Procedure

1. Soak dried berries in water in a refrigerator until they are very soft and have stopped absorbing water (approximately 36 hours). Dried berries can absorb substantial amounts of water so the volume of water should be at least 3 times that of the dried berries. Freshly collected berries may only need to be soaked for a few hours. (We recommend drying berries after collection if they can not be extracted immediately to avoid fungal problems).
2. Rinse berries in a sieve with water to remove husk residues and pick out small stems and other debris. Place berries in a deep mortar with a very small amount of water, just enough to cover them. Mash berries slowly with pestle.

The point of mashing is to break open the tough skin or husk, and slow, carefully controlled grinding is the best way to open the berry without damaging the seeds. This can be done by turning the pestle as you press the berries into the curved edge of the bowl. Mash until most or all berries have split apart, approximately 5 minutes.

3. Soak split berries in water for 24 hours to soften pulp further.
4. Work berries between fingers for approximately 5 minutes to loosen seeds from skin, pulp, and other chaff and to break up clumps. We recommend wearing gloves to protect your hands.
5. Put the crushed berries in blender and add water to make a 3:1 ratio of water to berries. Blend the mixture for 30-40 seconds on medium speed (this speed was labeled "chop" on the blender we used).
6. In sink, stack 5 mm, 2 mm, 0.991 mm sieve pans with the largest opening sieve on the top and decreasing in size. (A 5-mm sieve can be made by attaching hardware cloth to a frame which should be approximately the same diameter as the other sieves. The 2-mm and 0.991-mm sieves are standard sizes used for sieving soil.) The mixture in the blender will have separated into husks and pulp, and seeds and pulp. Slowly decant the upper portion into the sieves so that you pour most of the husks out. Using a scoop, ease out more husks and pulp, leaving

the bulk of seeds in the blender. Spray water forcefully over the husks to flush seeds through the screen (use a nozzle attachment which will allow you to push the seeds through sieves with high water pressure). The seeds which pass thru the 0.991-mm sieve are usually flattened and most are empty or have shriveled embryos. Aim the spray straight down to avoid scattering seeds near the edge of the sieve. Remove 5-mm sieve and discard husks collected on the screen.

7. Pour remaining husks, pulp and seeds from the blender into the 2-mm sieve. Spray again with water until all seeds have been washed through onto the 0.991-mm sieve. Remove 2-mm sieve and discard materials collected on the screen. Spray 0.991-sieve with water, then turn upside down over a collecting pan and tap sieve from the bottom with the scoop so the seeds and remaining pulp fall into the pan. Put this mixture back in the blender with a water to seed ratio of 3:1.
8. Blend at medium speed for 30 to 40 seconds. Pour through 2-mm and 0.991-mm sieves again and repeat process of sieve spraying and then transferring seeds to the collecting pan (#7). Transfer seeds from the pan to a small beaker or cup.
9. Pour a small amount of tap water over the seeds (just enough to cover). Then tilt the beaker to collect seeds along one bottom

edge and side of the beaker. The pulp will tend to settle in front of the seeds. Rotate the tilted beaker slowly; the motion and tilt will bring the lightweight pulp and chaff to the front, leaving most of the seed behind. Pour any floating seeds, which will come out first, into a hand-held sieve and set aside. Pour and scoop remaining water, pulp, and chaff into the 0.991 mm sieve, leaving most of the seeds in the beaker. Discard the pulp after picking out any remaining seeds (if desired).

10. Repeat #9. Once you have gotten most of the pulp out of the beaker, put the remaining seeds into the small, hand-held kitchen sieve (pore size no larger than 0.991 mm) containing the floating seeds. Rinse with water and gently shake dry. Pat the bottom of the sieve with cloth or paper towels to remove excess water. Spread seeds out for drying.

Lots will vary in the amount of pulp and chaff remaining at this point. Most are very clean, but some lots will still have some of the cell-covering material present. If necessary, this can be removed by hand (a gravity table might be helpful for this).

Seed Germination

Pacific madrone seed do not germinate without a cold stratification period. Once the stratification requirement has been met, germination is prompt with most seeds germinating in less than a week (Figure 1). Some previous

trials reported success with long (up to 93 days) cold stratification treatments (Roy 1974); however, we experienced substantial germination (> 20%) during stratification in a Puget Sound lot when stratification exceeded 40 days. We have a future trial planned to determine the variation in the stratification requirement with latitude and elevation.

Seed Storage

It has been suggested that dried seeds or berries can be stored at room temperature for 1 or 2 years but that sealed containers at refrigerator temperatures are recommended for longer storage (Roy 1974). We do not recommend storing the berries for an extended period of time as problems with insects or fungi seem to invariably result; thus, the seed should be extracted from the berries and dried if long-term storage is desired. Storing seed dried to 5.6% moisture content for 3 years in a sealed polypropylene jar at 3 to 5 °C did not appreciably decrease seed germination (Figure 2). Longer-term storage has not been documented.

Conclusions

More information is now available on variation in fruit and seed characteristics of Pacific madrone; this information may be helpful in planning future projects. A process has been developed to extract and clean seed prior to storage or germination; it involves several simple steps. Cold stratification is required for germination but once the stratification requirement has been

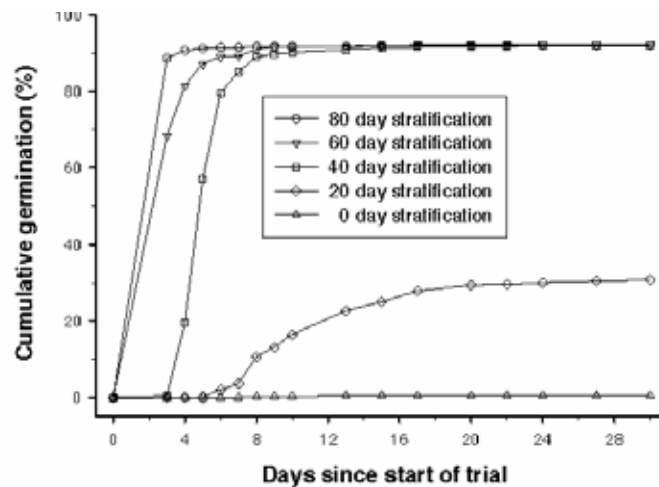


Figure 1. Effects of length of cold stratification periods on germination of a Puget Sound seed source of Pacific madrone.

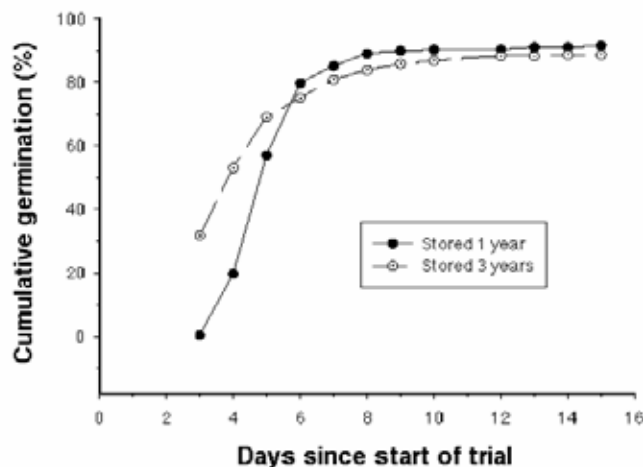


Figure 2. Effects of seed storage on germination of a Puget Sound seed source of Pacific madrone.

met the seed germinates quickly; thus, longer stratification periods should not be used without monitoring unless the seeds are in a storage environment with very little temperature fluctuation above 2°C. Seed germination is prompt but once the cotyledons emerge growth is slow. Future trials will examine methods to enhance seedling growth.

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