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Nursery Production Methods for *Arbutus menziesii*

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Abstract: There is a perception that Pacific madrone (*Arbutus menziesii*) is a difficult species to cultivate, but our efforts were quite successful in the propagation and growing of this species. We grew madrone seedlings on a fairly large scale with standard techniques of fruit collection, seed preparation, stratification, germination and seedling transplantation. The key component is to place the seedlings at a very young stage into containers so that further transplanting maintains the fine root system. In 1994, we produced over 250 seedlings that by the end of the growing season had an average height of 30–40 cm. In 1995 we produced >400 seedlings. These seedlings are now used to compare the effects of a sandy potting medium with the typical soilless medium used in most nurseries.

This paper presents a recipe for growing madrones from seed in a greenhouse. There is a perception that the Pacific madrone (*Arbutus menziesii*) is a difficult plant to grow; however, this is not true. During 1994–95 I was quite successful in the propagation and growing of this species at the Center for Urban Horticulture in Seattle, Washington. It is a plant that is very difficult to transplant but is ideal for container production in a nursery. Once the roots are in a container, the plant, along with the entire root system, can be taken out of the container and planted anywhere in the landscape. This paper focuses on container production of madrone and briefly discusses potential research in this area. There is also a short discussion on madrone research, the potential of future research directions and some precautions. Madrone seedling survival in natural settings is not part of this paper but is discussed by Pelton (1962) and Tappeiner, *et al*. (1986).

METHODS OF PROPAGATION AND PRODUCTION

Growing madrones is a 5 step process: 1) collection of seed material; 2) seed preparation including seed storage for occasions when immediate propagation cannot be done; 3) seed stratification (cold treat-

ment); 4) germination; and, 5) seed transplantation. This section discusses each of these 5 steps in chronological sequence from seed collection to transplantation.

Seed Collection

It is difficult to tell ahead of time which individual plant will produce a good fruit set. A tree, however, that has a particular kind of fruit set one year has the same fruit set year after year, or sometimes in alternate years. Perhaps this occurrence is related to stress. Each fruit contains approximately 8 or more seeds, so the number of fruits collected can give a rough estimate of the number of seeds that may be extracted and of seedlings that eventually can be grown. A tree with fairly short stature is ideal for seed collection because it is very difficult to get to a fruit that is 9–12 m in the air. Timing is also very important. The fruit needs to be ripe for success in growing (a ripe fruit is a deep orange color or sometimes almost red). The seeds themselves are not yet ready while they remain white or tan. They generally become black with blackish-brown seed coats as they ripen. Madrone fruits are favorites of birds, so one should not wait too long to harvest seeds or else there will be none available. When ripe fruits are available, they should be picked and placed in a pleated Ziploc bag with some information on the location and description of the tree. This can be important for tracking seedling characteristics relative to parent trees.

Seed Preparation

After collecting the seeds, it is necessary to separate the seeds from the fruit using either of 2 standard techniques of separation—the wet method or the dry method. The wet method is used in our research. The fruits in the Ziploc bags are separated from the peduncle (the little stem to which the fruit is attached). Water is poured into the Ziploc bags containing the fruits, and the bags are sealed and set in the sun for about a week until the fruits start to ferment. This step allows the seeds to be separated from the flesh of the fruit more easily. The fruits are then macerated. If a macerator is available, this process can be carried out in the macerator tub. Otherwise, the fruits are placed in a dish-tub and squashed by hand. The squashed fruits are then placed over a wire screen on a wooden frame (easily built with a screen that is larger than the standard size used for a screen door) with a collecting tub below. The fruits are mashed over the screen while simultaneously water is poured over them. The seeds pass through the screen into the tub while most of the flesh is caught on the screen. Some of the flesh that passes into the tub can be separated out by washing it through the screen several times with water. The water is poured off (decanted) or

is separated from the seed by pouring the mixture over a small mesh screen. When dry, any remaining flesh can be blown away leaving just the seeds. It is not important to remove all the flesh.

In the dry method, the fruits are thoroughly dried after which they are crushed into a powder. The mixture is placed on a wire screen and the seeds filter through. The seeds are then picked out from the dry fruit. The seeds can be stored at this point (after separation from the fruit but before stratification).

If the seeds are not to be stored, they should be soaked overnight in water. Some seeds will float and others will sink. The seeds that sink have a greater tendency to be viable. Any seed that floats is not worth keeping since it most likely is not viable. Again decant off the water and divide the soaked seeds into lots. This can done in a gross way or by counting them just as we do for research purposes. One lot should consist of about 300–400 seeds (a convenient number to sow in a seed flat). More than this amount will make separation of the seedlings difficult later.

Cold Stratification

This process requires the use of sandwich bags that fold over, not Ziploc bags. Place 2.5 cm (1 in) of fine seedling media mix in the bag. Moisten the mix but squeeze out any excess water, so that it is moist but not soaking wet. Throw one lot (300–400 seeds) into the prepared sandwich bag and shake it enough to mix the seeds and the medium. Place the bag in the refrigerator at 4ºC (40ºF). Repeat the process for the other lots of seeds. Mark the day the seeds are placed in the refrigerator and remove them from the cold after 60 days. The seeds are now ready to germinate.

Seed Germination

Prepare a seedling flat by adding fine seedling mix until the flat is almost full. Moisten the mix. Sprinkle the stratified seeds over the top of the prepared flat and place a little less than a cm of seedling mix over the seeds. The flat should be kept moist, not wet. Set the flat containing the stratified seeds in a warm place (15–18ºC) such as a greenhouse. The seedlings will begin to sprout in about 2 weeks.

Seedling Transplantation

The first 2 leaves that emerge are arranged opposite to one another and are called cotyledons (thus, madrone is a dicot). These are smooth and do not look like normal leaves. The next leaves have cilia and are arranged alternately. These are the first true leaves. Transplanting should not be done until at least 2, or possibly 4, of these true leaves appear. Transplanting the seedlings is a very delicate process

and much time and care should be dedicated to handling the seedlings. In addition, transplantation is best done during cooler weather so the risk of *Phytophthora* (damping off) infection is minimized.

Ten cm (4 in) containers are prepared by adding medium until the containers are half full. The seedlings are removed from the flat by gently teasing them apart with a fork, keeping as much of the roots intact as possible. A seedling is carefully dropped into the container half-full with medium. More medium is added until the level just reaches the top of the roots. Some seedling loss should be expected during transplanting because roots are damaged during the process.

Plants in the 4 inch containers are easily shifted to a larger container. The bigger the container, the better the seedlings perform, although it will require more medium. The madrones can then be moved outside when the weather permits, preferably at the end of one growing season and before the start of the next (*i.e.*, between the months of November and March in western Washington).

DISCUSSION — PRODUCTION AND FUTURE RESEARCH

Despite the relative ease with which madrones are propagated and produced, research comparing different techniques and materials is bound to yield even better results. For instance, preliminary research comparing different types of production media suggests that better growth is achieved in a sandy mix similar to madrones' native soil.

Upon propagation of a large number of madrones, it will be possible to evaluate the seedlings for disease resistance. When a few thousand plants are available, experiments can be done where some plants will be infected with a disease. These infected plants can then be observed for any disease resistance. Additional characteristics that can be evaluated once large scale propagation of difficult genotypes is mastered include responses to urban stresses such as soil compaction and pollution.

LITERATURE CITED

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