VEGETATIVE PROPAGATION OF

ABSTRACT

Success in rooting cold-hardy *Arctostaphylos* Adans. [Ericaceae] cuttings in Colorado is measured by particular attention to harvest timing, cutting preparation, sanitation, and media characteristics. Propagation methods used in Colorado piggyback on those used elsewhere and serve to simplify sometimes complex, if not unsuccessful, procedures. The vegetative propagation techniques and materials presented here should enable propagators to successfully root cold-hardy *Arctostaphylos* in high numbers.

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KEY WORDS

Ericaceae, cold-hardy, rooting, broadleaf evergreen

NOMENCLATURE

USDA NRCS (2006)

Arctostaphylos Adans.

COLORADO STYLE

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Arctostaphylos pugens. Photo by Jim Borland

According to Hickman (1993) and others (ITIS 2006; USDA NRCS 2006), 60 to 83 taxa of the broadleaf evergreen *Arctostaphylos* Adans. [Ericaceae] are native to North America, Central America, and Eurasia. They occupy lands from sea level up to more than 3050 m (10 000 ft) in elevation. Only 5 species (*Arctostaphylos patula* Greene, *A. pringlei* Parry, *A. pungens* Kunth, *A.* x *coloradensis* Rollins (pro sp.) [*patula* x *uva-ursi*], and *A. uva-ursi* (L.) Spreng.) (USDA NRCS 2006) are found east of the Pacific coastal states, and of these only 3 (*A. patula*, *A.* x *coloradensis* and *A. uva-ursi*) are reliably cold-hardy to plant hardiness zone 5 (–23 to –29 °C [–10 to –20 °F]) (USDA ARS 1990).

Early selections of cold-hardy *Arctostaphylos* in Colorado were made for height and spread, foliage color and habit, foliage density, stem and flower color, flower numbers, fruit color, and ease of propagation. These selection criteria are still applicable as evidenced by the recent release of Panchito™ Manzanita (*A.* x *coloradoensis*) and Mock Bearberry™ Manzanita (*A.* x *coloradoensis*) through the Plant Select® program (Plant Select 2006). These and other selections (for example, 'Roundleaf Panchito', 'Chieftan', 'Sleeping Beauty', and 'Cascade') have been selected from Colorado and Utah wild populations (Skogerboe 2003).

TAKING THE CUTTINGS

Time of Year

The favored and perhaps only successful time of year to collect wild cuttings is during frost seasons (Chandler 2000; Truscott 2002; Skogerboe 2003; Hart 2005). So little rooting success has been attained during other times that some propagators would not think twice about strapping on a pair of snowshoes to gain access to a collecting site.

There are exceptions to the general rule of winter cuttings. We have always been successful with a few cuttings from either a general population collection or specific clone taken at other times, but the rooting rate has usually been in low percentages, the rooting time long, the roots produced of low quality, and the growing-on fraught with other problems.

A noteworthy exception found at the Denver Botanic Gardens (DBG) was the general year-round rooting ability of cuttings taken from plants under outdoor cultivation, and especially from those cared for in a heated and supplemental-lighted greenhouse.

Harvesting

Only terminal cuttings are taken, sometimes many at a time with the cutting of a terminal umbel consisting of several shoots. These are placed into a plastic bag, misted with water, and the bag sealed and kept on ice, if necessary, to keep the cuttings cool until they reach the propagation facility. Cuttings can be refrigerated for up to 2 wk before they are prepared for sticking.

SANITATION VIGILANCE

A critical departure is made at this point to make caution of the single most important cause for failure in rooting *Arctostaphylos*. This departure is called "sanitation." *Arctostaphylos* cuttings cannot be treated like most other species' cuttings in which only a modicum of sanitation may be necessary.

Everything that comes in contact with cuttings must be sterilized. A cheap and effective means for sterilization involves nothing more than a 10% solution of common household bleach made by mixing 1 part household bleach (5.25% sodium hypochlorite) with 9 parts water. Liberally spread, apply, or soak the bleach solution over anything that might come in contact with the cuttings. This includes gloves, cutting tables, cutting knives or pruners, flats, pots, and a portion of the propagation bench that extends beyond that to be used for rooting (Figure 1).

If steam is available, steam the cutting bench, especially if wood is used in the benching construction. If not, soak everything with the bleach solution and let sit for 30 min. Alternatively, ZeroTol™ or Green-Shield® for disinfection purposes is effective as well (Bone, personal observation).

PREPARING THE CUTTINGS

Initial Preparations

Single-stem cuttings of current year's terminal growth, approximately 2.5 cm (1 in) to 7.6 cm (3 in) long are prepared by removing the lower leaves by snapping them off (Figure 2). Any leaves covered by the rooting medium will almost certainly die and give potential rise to disease infestation. Some propagators remove developing, energy-depriving flower buds at this step by pinching these away.

Variations on the following are possible, but great success was attained by rinsing the cuttings in a 10% household bleach solution (as described above) by grabbing a handful of cuttings and swishing them back and forth in the solution for approximately 15 to 30 s, followed by a rinse in clean tap water (Borland, personal observation). Scott Skogerboe of Fort Collins Wholesale Nursery uses a ZeroTol™ rinse after storing the prepared cuttings in a refrigerator overnight (Skogerboe 2003).

Wounding the Cuttings

Although simple, non-wounded cuttings will root, they often have fewer and poorer quality roots. Too often the non-wounded cuttings would only callus and not produce roots except after very long periods in the propagation bench (Borland, personal observation).

A greater profusion of roots can be caused to grow if cuttings are wounded before applying the rooting hormone and sticking. This wound can be made in a number of ways, but the simplest is by utilizing a wounding device made

from several (3 to 4) single edge razor blades taped together (some make a small wooden handle into which the blades are inserted).

The wound is made by drawing lightly down about 1.3 cm (0.5 in) of the lower portion of the cutting at a very slight angle (Figure 3). For speed and efficiency, only one movement need be made with this device on only one side of the cutting, but wounding both sides will result in more rooting from both sides of the cutting. Only the slightest degree of pressure is needed to make the wound, sufficient only to slice through the thin, green bark, making mere contact with the wood beneath.

The same wound can be made with a thin-blade, razor-sharp knife (grafting knife is preferred), but a much higher degree of care is needed to complete it. Another alternative is to use the same knife to skin a very thin and narrow strip of only bark from 1 or 2 sides of the cutting. With practice, this can be done quickly with a small number of cuttings.

Treating the Cuttings with Rooting Hormone

All the traditional rooting hormones work. The fast and easy quick-dip method with liquid hormones is effective—a personal favorite was some mixture of NAA and IBA that resulted in a total concentration of 10000 to 20000 parts per million of active ingredients (Borland, personal observation). Other successful rooting hormone treatments include 1:10 Woods Rooting Hormone® (Skogerboe 2003) and Hormex #8® (Chandler 2000; Truscott 2002).

The senior author dipped only the very base of the cutting (1 to 4 mm [0.03 to 0.13 in]) for less than 5 s, but the junior author and Scott Skogerboe prefer dipping 1.3 to 2.5 cm (0.5 to 1.0 in) deep for up to 15 s (Figure 4). Occasionally, the base of the cutting would be killed with rooting oc-curring above this point. If everything has been kept clean, disease infestation into this dead material presented no problems.

Figure 1. Sanitation is key to rooting *Arctostaphylos*. Spraying a dilute bleach solution on everything that might touch the plant materials is an essential habit. Photo by Mike Bone

Figure 2. Cuttings should be single-stemmed, about 7.5 cm (3 in) long, and have the lower leaves removed by pinching. Photo by Mike Bone

In the preparation of several thousand cuttings, the process was interrupted periodically, about every 100 cuttings, to re-sterilize all equipment and surroundings.

Usually, bunches of cuttings can be dipped at once and several hundred can be prepared before they must be stuck in the propagation bed. If there was any delay, the cuttings were covered with a clean damp cloth or misted with plain water to prevent moisture loss.

THE PROPAGATION MEDIA

Media of many types have been used for *Arctostaphylos* but the one finding a great deal of favor with many propagators is unadulterated perlite, preferably of a medium grade or size. Perlite is a very light product, even when wet, and thus is less damaging to the rather delicate roots of *Arctostaphylos* when it is time to remove the rooted cuttings from the

Figure 3. A simple knife with 3 to 4 single-edge razor blades, duct taped together, can be gently pulled once across the stem to make a series of shallow wounds to promote rooting.
Photo by Mike Bone

Figure 4. Treating cuttings with hormones improves rooting success. Photo by Mike Bone

propagation bench. Used perlite should be sterilized or pasteurized before using on additional *Arctostaphylos* cuttings.

STICKING THE CUTTINGS

Prepared cuttings are stuck close together in a leveled perlite bed, tray, or pot by first making a deep crease in the perlite with a sterilized thin, flat piece of rigid plastic or metal. Cuttings are stuck only deep enough to prevent them from falling over and in rows spaced close enough such that the cuttings touch on all sides (Figure 5). Watering-in the cuttings sufficed for settling the perlite.

BOTTOM HEAT

Rooting *Arctostaphylos* cuttings without bottom heat can be successful but the process has proved to be an exercise in futility because rooting times are excessive. The internal resources of the cuttings can be maintained for only so long, and the chances for disease contamination are greatly increased. Bottom heat should be properly installed for even heat distribution, grounded, and thermostatically controlled to provide constant 21 to 24 °C (70 to 75 °F) at all times.

MIST

Mist should be provided such that a thin film of moisture is on the leaves at all times during daylight hours. This should be provided by some type of timing device that allows the system to operate from sun-up to 1 h before sundown, at which point the system should turn off and allow the cuttings to dry before nightfall.

The mist regulator at the DBG was an electronic leaf-type device that utilized the evaporation of moisture from a metal leaf to activate a mercury switch that turned on the misting controls and valves to supply mist. A clock device overrode the misting control and provided electricity to the controls during only daylight hours. This was adjusted to account for the changing nature of day length. This system has since been updated with the installation of a Schaefer Solar 12C controller (Davis Engineering, Winnetka, California; 818.993.0607), a more flexible mist-controlled device that can adjust mist operation according to an accumulation of solar energy.

CARE OF THE CUTTINGS IN THE PROPAGATION BENCH

Rooting of most collections began in 3 to 4 wk with success rates varying from 50% to as high as 90%. It was occasion-

ally observed that heavy callusing would impair rooting beneath the callus.

Disease, when it occurred, was undoubtedly *Phytophthora.* Infected cuttings were as good as dead and were removed before spreading the disease to other cuttings. Individual yellow or fallen leaves were removed daily. Sticking cuttings into individual, small containers or plugs may offer the opportunity to isolate insect or disease infestations (Bone, personal observation).

The fungicide Subdue® was effective against the disease, as are perhaps others, but none have much in the way of curative powers. Infected cuttings will continue to die and must be removed. Benched cuttings can be drenched with ZeroTol™ weekly as a prophylactic measure (Bone, personal observation).

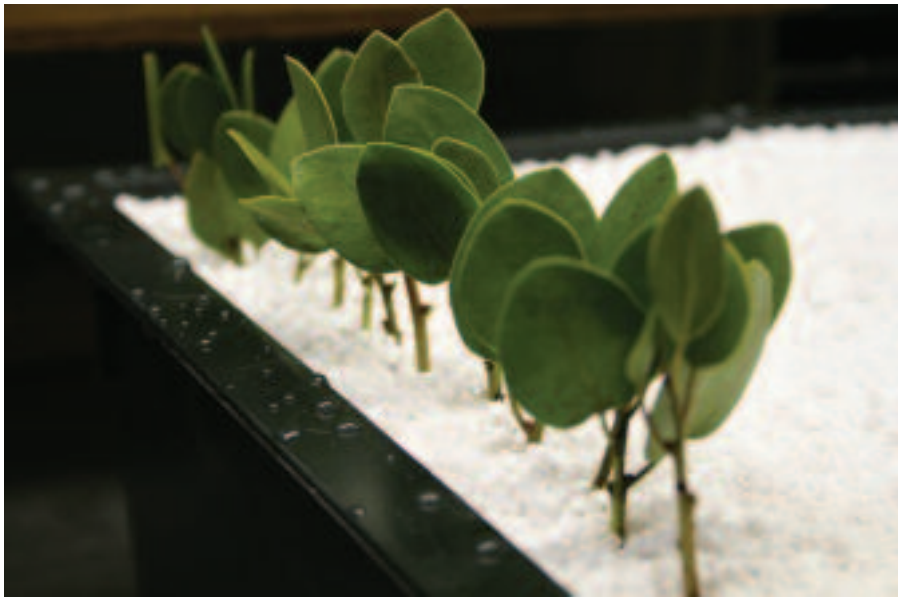

Figure 5. Cuttings should be inserted into 100% perlite at a spacing where the leaves just touch their neighbors on all sides. Stems need only be inserted deep enough to prevent them from tipping over. Photo by Jim Borland

REMOVING THE CUTTINGS

Roots of *Arctostaphylos* cuttings are delicate and care should be used when removing the cuttings from the rooting containers (Figure 6). Entire rooted bunches can be removed and then separated on the potting bench immediately prior to potting. Those not rooted can be returned to the rooting bed.

Figure 6. Well-rooted cuttings ready for transplanting. Photo by Jim Borland

POTTING THE CUTTINGS

The Sunshine® potting mixes (Sun Gro Horticulture, Bellevue, Washington) used at DBG provided barely sufficient aeration for *Arctostaphylos,* and additions of up to 1/3 more perlite were typically incorporated (Borland, personal observation). Skogerboe (2003) inoculates his potting soil with Plantshield® (BioWorks Inc, Fairport, New York), a product that introduces the beneficial fungus *Trichoderma harzianum.*

Rooted cuttings would normally be potted to 250 SVD pots (9 cm deep x 6 cm top square, 250 ml volume [3.5 in deep x 2.5 in top square, 15 in^3]) (TO Plastics Inc, Clearwater, Minnesota), which they will grow on for several months before considering a move up to 0.9-l (1-qt) or 3.8-l (1-gal) containers.

Rooted cuttings were planted at the same depth as they were in the propagation container and without compressing the soil around the cutting. The first gentle watering settles-in the soil. If a few do not fall over during the first watering, then all the cuttings probably have been planted too deeply.

FURTHER GROWING ON

Little to nothing is known about the elemental requirements for these plants, but the senior author fertilized them at every watering with 100 to 200 ppm nitrogen (N) and potassium (K, not K_2O).

Container soil pH at the DBG ranged from 5.4 to 7; depending on the source of the soil and the length of time it had contained a growing plant. One soil test

conducted in the field on an *A. patula* population growing on the Uncompahgre Plateau, Colorado, was pH 7.4 in a sandy soil. Our plants have been grown now in mineral landscape soils of equal or higher pH with little problem.

ACCELERATED GROWTH

Arctostaphylos can be forced to produce more than the one normal flush of growth per year by: 1) starting the cuttings early in the frost season; and 2) utilizing warm temperatures (18 to 24 °C [65 to 75 °F]) during the day and high pressure sodium (HPS) lights (3333 to 7222 lux [300 to 650 ft^3]) during the night. The HPS lamps used at DBG caused so much shade that these lamps were run continuously.

Stocky, full plants can be encouraged through a light pinch of the new growth just before it becomes woody. Additional semi-hardwood cuttings could be taken from these plants and rooted with lower concentrations of rooting hormone and no exposure to freezing temperatures (Borland, personal observation).

CONCLUSION

Clues to the successful vegetative propagation of *Arctostaphylos* were originally appropriated from propagation protocols for perhaps the most important horticultural member of the ericaceous family—*Rhododendron*. Attention to the finer points of harvest timing, sanitation, wounding, hormone treatments, and media characteristics serve the propagation of both species well.

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