CONCLUSIONS

The results showed that there was a difference between the type of wrap/covering used and the type of medium used. Hormone treatment showed no difference in the probability of rooting. However, Hormex 8 did show a difference in root length: those treated with Hormex 8 had longer roots than those without Hormex 8. Treatments with foil were two times more successful than those using the rooter pot. The medium used showed the most difference: peat moss did the best with the longest average root length at 7.9 inches and it had the most successful and consistent treatments of the three. Over half the treatments that received peat moss had roots by Day 77. Peat moss with Hormex 8 in foil proved to be the best treatment combination for air layering litchis in California.

LITERATURE CITED

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Propagation of *Arbutus* 'Marina' by Air-Layering©

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INTRODUCTION

Arbutus 'Marina' is a strikingly attractive California-hybridized shrub grown and sold in nurseries, often pruned into multitrunk or standard form. The appearance of 'Marina' is evocative of the madrone (*A. menziesii*), a powerfully beautiful California native tree. Unlike the madrone, the 'Marina' fits a wide range of landscaping needs and is resilient to most human care. While the madrone is not as adaptable as the 'Marina' and rarely survives outside of its native environment, the 'Marina' can survive in good- or poor-quality soil, in a xeriscape, or in the middle of an irrigated lawn used as a small tree or screening shrub and is a viable option for those who want to echo the California native landscape in their own landscapes.

The higher cost and limited availability of the 'Marina' is primarily because it is recalcitrant to propagation by seed and cuttings. The 'Marina' is available to growers from specialty propagators as micropropagated plantlets, liners from micropropagated plantets, and liners from cuttings. From our experience, the cost is from $1.25 to $1.75 per liner, and the time necessary for liners to reach a saleable 1-gal size is from 6 to 9 months. Local retail and wholesale nurseries routinely find themselves unable to meet the demand for finished 'Marina' standards, multitrunks, and shrubs.

Propagation by air-layering has been successfully used to reproduce species that are not readily propagated by seed or cutting. Air-layering techniques have subtle variations, but in general an incision or wound is made on a plant stem, the bark is removed, a rooting hormone is applied, the stem at the incision is covered by a wad of moisture-retaining material (such as sphagnum moss or rooting rockwool cubes), followed by an occlusive wrap. If the procedure is successful, the plant's natural auxins (traveling down from the stem tip) and the applied rooting hormone will stimulate rooting at the site of the incision. Once sufficient roots have appeared, the stem is cut from the shrub, the wrapping removed, and the rooted stem is potted in a container. Often, the newly potted air-layered plants are placed under mist or shade for a few weeks to aid in the transition from air-layer to pot-rooted plant.

The purpose of this study was to explore the possibilities of propagation by air-layering as a means to predictably produce large 'Marina' plants in a shorter period of time, as an alternative to relying on purchase of liners.

Secondary issues explored were the response of 'Marina' to artificial long-day conditions (long-day lighting at night) and the impact of inoculation of the moist rooting material with a small amount of medium (with roots) taken from the root zone of the 'Marina' being air-layered.

MATERIALS AND METHODS

Twelve large, 2-year-old, 15-gal *A.* 'Marina' were provided by David Fross at Native Sons (Nipomo, California). They were transported to Greenhouse #9 at the CalPoly San Luis Obispo (SLO) Horticulture Unit at the end of Dec. 2004. A hard pruning was performed to induce vigorous auxin-laden new growth. Long-day lighting conditions were initiated on 10 Jan. 2005. The 'Marina' plants were moved to the Courtright shade-house in June.

The layers were made from 1 July 2005 to 30 Sept. 2005. Stem diameters air-layered were from 4.5 to 15 mm. The distance from bark removal (air-layer site) and stem apex ranged from approximately 20 cm to 1 m. In preparation of the air-layer site, the leaves and small branches in the site area were removed. A 1.0 to 2.0-cm strip of bark, completely encircling the stem, was removed. A portion of the sites were left untreated by the Dip 'N Grow® hormone preparation. The area without bark was then painted with a mixture of Dip 'N Grow (1.0% indole-3-butyric acid and 1-naphthaleneacetic acid 0.5%) and DipGel (a gel thickener for Dip 'N Grow), both of which were provided by Dip 'N Grow®, Inc. for this study. The dilution strengths were 5000, 7500, and 10000 ppm. Application of the hormone mixture was accomplished using a 1-inch paintbrush. The hormone mixture was applied to the distal (closest to the shoot apex) edge of the bark-removal site. A handful of moist green moss was wrapped around the site. Some of the sites' moss was inoculated with approximately ½ teaspoon of potting media taken from the plant's root mass, 2–3 inches below the surface of the medium. The green moss was covered by a zip-lock plastic bag (both ends cut out, forming a sleeve, with the zipped opening on one side), secured with 4-inch computer-cable ties, then aluminum foil. The zip-lock opening facilitated nearly effortless "quick-peak" assessments of progress.

Inspections of layer sites were performed at approximately 4- to 5-week intervals. Harvested air-layers were potted in 1-gal containers and placed in CalPoly's mist unit. Some of these were "harvested" by winds. Although none of the wind-harvested layers were fully rooted, those with roots and those with moderate to abundant callus were potted and placed in the mist unit with the fully rooted, harvested layers.

RESULTS AND DISCUSSION

Harvests of layer sites started in the first week of October 2005. The fully rooted air-layers were originally placed in July, on stem diameters of 7.0–10.0 mm, and all three Dip 'N Grow dilution-strengths were represented in the fully rooted layers.

There were three issues encountered during this study: (1) the learning curve for air-layering technique for this species, (2) the unanticipated heat-loading of the wrapped air-layer sites during the height of summer, and (3) the ferocity of the Santa Ana winds. All three issues produced air-layer site failures, which in a more controlled setting and with a more experienced air-layer technician, would not have occurred. Therefore, the failure rate was falsely elevated over what could be expected in a more appropriate environment.

This study is not complete. It is anticipated that the last of the layers will root or fail by December 2005. The original plans were for the study to extend through winter, which would allow us to assess the impact of long-day lighting on the speed and percentage of air-layer rooting. Unavailability of appropriate greenhouse space prevented the completion of this part of the study, and it is anticipated that no further air-layers will be placed.

Of the layers treated with no hormone, 45 out of 68 (66.2%) failed. Of those that failed, 22 (48%) had been soil inoculated and 23 (51%) had not. The average days to failure was 41.7, with the earliest failure at Day 32 (32 days following the placement of the air-layer) and the latest at Day 96 (due to wind breakage). Twenty-three of the 68 sites (33.8%) did not fail. Of these, eight (34.8%) were soil inoculated, and 65.2% were not. Of those that lived, to date two (8.7%) developed roots (at 37 days).

Of the layers treated with 5000 ppm hormone, 25 out of 64 (39%) failed. Of those that failed, 15 (60%) had been soil inoculated and 10 (40%) had not. Average days to failure was ~38. Five sites were broken by wind. The earliest failure was at Day 31, and the latest was at Day 47. Thirty-nine (60.9%) of the sites have survived. Of those, 18 (46.1%) were soil inoculated and 21 (53.8%) were not. Roots developed on 19, with roots first observed at an average of 72.4 days post air-layer placement. Roots appeared on 48.7% of the survivors and appeared as early as 41 days and as late as 104 days post placement.

Of the layers treated with 7500 ppm hormone, 15 out of 59 (25%) failed. Of those, five (33%) were soil-inoculated and 10 (66%) were not. One broke from the winds. Average days to failure was 49; the earliest failure was noted at Day 34, and the latest at Day 86. Seventy-six percent survived, of which 16 were soil innoculated and 28 were not. Thirteen (28.9%) rooted. Average days to rooting was 61.7 days, with the earliest roots noted on Day 38 and the latest on Day 90.

Of the layers treated with 10,000 ppm hormone, 27 out of 49 (55%) lived, of which 13 were soil-inoculated and 14 were not. Ten of 27 (37%) rooted, with the earliest roots appearing on Day 40 and as late as on Day 96. The average days to root was 70.4.

Callus formation was rated as slight, moderate, and abundant, and all three grades were noted as early as 38 days following air-layer placement. All three levels of callus formation went on to develop roots. The abundant callus formed the largest mass of roots in the shortest time. None of the non-hormone-treated sites developed abundant callus and the majority of abundant and moderate callus formation was on sites treated with either 5000 or 7500 ppm hormone.

On six of the sites that were not treated with rooting hormone, on the stems under the light-occlusive air-layer wrapping, shoots developed on some of the nodes. The nodes where shoots developed were both distal and proximal to the bark-removal site. These shoots were removed as they were encountered in the process of assessing for callus and root formation.

CONCLUSION

The response of the 'Marina' to air-layering was good, with the first rooted layers harvested about 90 days after placement. The response to the hormone dilutions was rapid and acceptable, with the 5000 and 7500 ppm dilutions consistently producing moderate and abundant callus as early as 38 days post air-layer placement. Stem diameters between 7.0 and 12.0 mm had the best results, with the most abundant callus formation and earliest root formation. The 4.5- to 6.5-mm diameter stems had quick callus formation, but were more inclined to break or otherwise fail. The results of soil inoculation of the moist air-layer material appears equivocal to date, with no consistent trends noted. The 'Marina's had a very gratifying response to long-day lighting, producing exuberant new growth in January, very close to the level of growth seen in the summer. This may indicate a possibility that the 'Marina' might also favorably respond to long-day lighting with callus and root formation at a similar rate and quality as that produced during the summer months. This might indicate that air-layering propagation of *A.* 'Marina' may be possible on a year-round basis, without loss of productivity during the shorter, colder days of winter, if they were long-day lighted and provided adequate warmth during the winter.

Improving Handling and Rooting of *Thunbergia alata*©

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INTRODUCTION

Thunbergia alata, common name "black-eyed Susan vine," is an increasingly popular ornamental vine named for the black eyes of its miniature flowers. *Thunbergia alata* is commonly propagated by seed and stem-and-two-leaf nodal cuttings. Large-scale cutting production of *T. alata* is performed in Costa Rica by Ball Flora Plant. Many of the cuttings experience leaf disintegration and literal melting usually within the first week of planting, resulting in failure to root and death. A study was launched to examine factors affecting the rooting of *T. alata* Sunny™ Lemon Star black-eyed Susan PPAF vine cuttings.

MATERIALS AND METHODS

Unless otherwise noted, no cuttings of *T. alata* were treated with rooting hormones in the following experiments.

Carbohydrates and Rooting. One hundred-fifty *T. alata* Sunny™ Lemon Star black-eyed Susan cuttings were separated into basal (nodes 1 and 2) and nonbasal (nodes 3 and 4) treatment groups to examine the effect of internodal cutting position on rooting. Hamilton et al. (2002) found that leaf size of *Coleus* cuttings greatly influenced rooting quality. Lemon Star basal cuttings often have larger leaves than nonbasal cuttings. Cuttings were planted in sterile Oasis® cubes, placed in a misting house with bottom heat under intermittent mist at 4 sec mist every 4 min, and propagation survival was recorded after 3 weeks.

Respiration and Temperature. The effect of temperature on respiration rate of *T. alata* Sunny™ Lemon Star black-eyed Susan was examined using a static