

Propagation of Indigenous and Endemic Ornamental Hawaiian Plants

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Hawaii's nurseries have been stimulated to begin production of indigenous plants as a result of a state policy requiring the use of these plants in public landscapes. While many native plants can be grown from seed, vegetative propagation of ornamentally attractive selections is necessary to maintain these ornamental qualities. In this paper, propagation practices are described for *Hibiscus arnottianus*, *H. clayi*, *H. brackenridgei*, *Gossypium tomentosum*, *Sida fallax*, *Wikstroemia uva-ursi*, *Heliotropium anomalum*, *Osteomeles anthyllidifolia*, *Vitex rotundifolia*, *Artemisia australis*, *A. mauiensis*, *Erythrina sandwicensis*, *Metrosideros polymorpha*, *Pittosporum spp.*, and *Psydrax odorata*.

INTRODUCTION

With the passage of Act 73 (relating to the use of native plants in landscaping) in 1992 by the Hawaii State Legislature, landscape contractors who bid on public projects were required, where feasible, to use Hawaii's indigenous species in the landscape. Wording in the Act included the purpose, "to encourage the propagation of Hawaii's indigenous species of land plants." This measure was enacted to prevent the decline of Hawaii's unique native flora by encouraging its use in the landscaping of public buildings, facilities, and housing projects developed by the State.

Since there has not previously been a major market for Hawaiian native plants, nurseries have had to speculate a bit and build up stock for the landscape industry to evaluate. Recently, private and public developers have begun to incorporate native plants into their landscaping. A number of suitable ornamental plant materials have already been identified (Bornhorst, 1996; Bornhorst and Rauch, 1994; Weissich, 1994), but some are difficult to propagate and stock plant material is lacking for others.

This paper summarizes some of the successful propagation systems developed at the University of Hawaii as well as at various botanical gardens and by native plant enthusiasts. Some of the information is research-based; some is anecdotal.

MATERIALS AND METHODS

Cutting propagation research carried out at the University of Hawaii is usually conducted under intermittent mist with a cycle of 6 to 8 sec "on" time every 5 or 6 min (depending on the timer used) under 30% saran shade and ambient outdoor temperatures, in media of equal parts coarse perlite and vermiculite or No. 2 vermiculite alone. The rooting compounds used have been either commercial talc dust preparations such as the Hormex or Hormodin series, liquid preparations from Dip-N-Grow or Woods Rooting Compound (both with 2:1 IBA to NAA ratios), or 30% alcoholic solutions prepared from crystalline IBA. When citing the work of others,

every effort has been made to determine what propagation methodology was used, but most of the reports have failed to describe the conditions of propagation.

ORNAMENTAL HAWAIIAN PLANT MATERIALS

Hibiscus arnottianus var. *punaluuensis* (koki'o ke'oke'o) is a fragrant, perpetually white-flowered hibiscus native to a small mountainous valley on the island of Oahu. It can grow into a small tree of about 30 ft. in height, but is often found in our landscapes as a hedge or accent plant. It can be grown readily from seed, but terminal and sub-terminal cuttings root readily following treatment with 4000 to 7500 ppm IBA : NAA (2 : 1 ratio) (Tokumaru, 1997), and Hormex #3 has also been used successfully (Bornhorst, 1996). Grafting and air layering are also reported as feasible techniques (Rauch et al., 1995).

Other native hibiscus species with ornamental potential are *H. clayi*, *H. kokio* subsp. *saintjohnianus*, and *H. brackenridgei*. *Hibiscus clayi* is native to the island of Kauai. It forms an upright growing shrub or small tree with solitary dark red flowers and makes a handsome specimen or accent plant. *Hibiscus kokio* subsp. *saintjohnianus* is another Kauai native with orange flowers that can occur as a shrub or small tree. It makes a colorful landscape plant in a sunny location. Both of these natives can be grown from freshly collected seed with no difficulty. Cutting propagation is enhanced by the use of auxins such as 4000 to 6000 ppm IBA : NAA (2 : 1 ratio) on terminal cuttings under intermittent mist. About 8 weeks is required for rooting.

Until recently, *H. brackenridgei*, Hawaii's State Flower, was on the endangered species list and it was illegal to own plants without a permit under State law. Act 381 was passed in 1997 to remove that prohibition if the plant came from cultivated sources and not from the wild. Thus, arboreta and botanical gardens are licensed to propagate and sell from their established plants. *Hibiscus brackenridgei* is a somewhat short-lived (5 to 6 years in the wild) sprawling shrub or small tree found on all of the main islands of Hawaii (Bornhorst, 1996). It produces large, clear yellow flowers in the spring months and does not flower during much of the rest of the year. It can be grown from seed or cuttings. Cuttings require auxin treatment and the 4000 to 6000 ppm concentration range of IBA : NAA (2 : 1 ratio) seems to work well.

Another member of the Malvaceae with ornamental potential is the Hawaiian cotton or ma'o, *Gossypium tomentosum*. The plant habit ranges from sprawling shrubs to sculpted mounds to prostrate groundcovers. The foliage is silvery green and palmately lobed. The yellow flowers are 2 to 3 inches in diameter and produced year around. It can be used as a background or filler plant, as a specimen plant, shaped into a hedge, or grown in a container. Terminal cuttings, both soft and semihardwood, rooted in 3 to 4 weeks under mist following treatment with 2000 ppm IBA in either liquid or talc dust formulation. Seed propagation is also used, but the growth habits of resulting plants are not as uniform as from vegetative means. Following removal of the short brown fibers from the seed, a 24-h presoak in water or scarification enhances germination (Rauch et al., 1993a). The 'ilima, *Sida fallax*, is a malvaceous, low-growing woody shrub with a range of leaf textures and growth habits, bearing yellow to orange flowers year around. Hundreds of the small flowers are strung into leis that represent the island of Oahu. Cultivated forms have been selected for prolific flowering as well as for prostrate, upright, and mounding growth habits. Coastal-derived plants are suitable for hot, dry locations, while the upland

types are more upright and better adapted to irrigated landscape situations (Rauch et al., 1993b). 'Ilima can be propagated from seed or cuttings (Rauch et al., 1993b), but extremely wet intermittent mist conditions cause leaf drop and poor take in rooting of cuttings. The methods used for ma'ō should work for 'ilima.

One of the more widely planted natives is 'akia, *Wikstroemia uva-ursi*, used as a foundation planting, ground cover, or mass-planted in beds or borders. It has good tolerance to coastal conditions. It is generally a prostrate or sprawling shrub, with grayish-green ranked foliage and dense branching. The flowers are tubular and yellow-green. The single-seeded fruits are about 3/8 inches in diameter and orange to bright red in color. Propagation by seed is common and easily done, but seed is sparse in some years. Propagation by cuttings was regarded as difficult, but research has shown that recently matured terminals about 5 to 6 inches (12 to 15 cm) long can be rooted in high percentage with wounding and rooting compounds (Matsuda and Criley, 1980; McEwen, 1995). The wound was made by a quarter-inch long incision through the bark at 2 or 3 sites at the base of the cutting or by pulling off some lower leaves with a strip of bark. IBA at 3000 ppm and Dip-N-Grow at 1 : 9 and 1 : 4 dilutions produced 80% to 100% rooting within 6 weeks. The talc dust formulation of IBA at 3000 ppm was not as satisfactory as the liquid.

Another coastal plant material, hinahina, *Heliotropium anomalum* var. *argenteum*, finds use as a groundcover for beach exposures and well-drained sites. Its rosettes of silvery blue-green foliage contrast well with taller, dark green vegetation or with the dark hues of rock walls (Crivellone, 1991). While it requires regular watering in cultivation, it also requires good drainage. Soft, herbaceous cuttings of hinahina root in 3 weeks under intermittent mist without the use of rooting hormones and neither the root quality nor percent rooting were improved if IBA strengths of 500 to 2000 ppm were used (Crivellone and Rauch, 1991).

Indigenous to Hawaii, the Cook Islands and Tonga and up into the Ryukyu Islands near Japan, 'ulei, *Osteomeles anthyllidifolia*, is one of the few members of the rose family that is found naturally on all of the main Hawaiian islands. 'Ulei's habitat ranges from open fields and shrublands, dry to mesic forests, to disturbed areas where it will compete well with alien weeds. The dark-green glossy foliage is odd pinnately compound and fine to coarse in texture. This plant can mound up to 10 ft (3 m) in height, but is most often a sprawler-spreader. It takes pruning well and finds use as mass plantings, ground covers, rock wall, bank covers, and low hedges. The hard seeds require about 2 months to germinate and seedling growth is slow. Since fine-textured and compact forms may be selected from seedlings, vegetative propagation may have some advantages. Recently matured terminal cuttings rooted with only 67% success after 8 weeks following treatment with 6000 ppm IBA (the highest concentration tested).

Pohinahina, *Vitex rotundifolia*, is another indigenous plant found along sandy beaches and rocky shores. It is a sprawling shrub with round, grey-green/silver leaves and purple-blue flowers. While it is often wind-pruned to only a couple feet in height, in cultivation it will mound up to about 4 ft. It can be maintained as a groundcover, as a natural or pruned hedge, foundation plant, bank cover, in rock gardens, and at the tops of retaining walls. As the seeds are difficult to extract from the fruits, the whole fruits can be planted after soaking in water for 48 h to soften them. Germination is slow, about 3 to 6 months (Koob, 1998b). Cuttings are faster. Nonflowering terminals about 4 inches long will root in 3 to 4 weeks under mist

following treatment with IBA (Hormex series 3, 8, and 16 have all improved root quality over no hormone treatment). Seedlings and rooted cuttings should be pinched after transplanting to encourage branching.

Continuing in the silver-foliaged plants, ahinahina, *Artemisia mauiensis* and its close relative *A. australis*, are attractive ornamentals related to sagebrush and wormwood. Small shrubs with finely divided foliage, they do well in full sun and well drained sites. They are wind-tolerant, and respond well to pruning to shape them. *Artemisia mauiensis* is found at 6000 to 7500 ft elevations on the lee side of Mt. Haleakala, while *A. australis* is found on windward coasts. Propagation from seed is possible if fresh seed is used, but it is very fine and does not store for a long time. Sow on a fine-textured potting medium kept moist during germination then transplant seedlings after the second or third set of true leaves appear. *Artemisia australis* roots easily from cuttings, although weak hormone solutions speed root formation, but *A. mauiensis* requires medium strength rooting hormones. Tip cuttings 3 to 4 inches long are used and a high humidity environment yields better results than intermittent mist. Rooting takes 4 to 8 weeks, after which they can be transplanted (Koob, 1998a).

There are many species of *Erythrina* worldwide, and one of them, *E. sandwicensis*, is found in the dry, leeward lowlands of nearly all the Hawaiian Islands. They are tolerant to drought, salt air and wind, and are thus suitable for dry areas and coastal sites (Rauch and Hensley, 1993). Known as wiliwili, these are small trees (to about 30 ft tall) of moderate to fast growth rate. The pea-like flowers are borne in late summer and range in color from red-orange to salmon, white, yellowish, and chartreuse. The easy-to-germinate seeds (5 days) are borne in small twisted pods (wiliwili means twisted). Germination is enhanced by scarification or an overnight soak in warm water. They can also be grown from tip cuttings and air layers. Rooting hormone treatment probably enhances the speed of rooting, but published information is not available.

The 'ohi'a lehua, *Metrosideros polymorpha*, is found all the way from sea level to high elevations, from wet coastal areas exposed to salt spray to bogs nestled high in the mountains, and on new lava flows. There are many forms (hence, the species name polymorpha) ranging from prostrate ground hugger to shrubs to trees of 100 ft (30 m) height. The elliptical, leathery, sometimes tomentose, foliage is borne densely along the stems. Their landscape use is as accent plant, specimen, container or foundation plants, but good drainage is a necessity despite their need for regular watering. The flowers consist mostly of brilliantly colored stamens and pistils in reds, oranges, yellow, and occasional pinks. White flowers are mentioned in descriptions of these plants, but there are no white forms in cultivation. Some forms are easy to root and others quite difficult. Since many of the ornamental forms are relatively easy to root, these forms should be the ones propagated for the nursery and landscape trades. Seed is fine and may be sown on the surface of a moist medium where it will germinate in about 10 days. Transplanting is done after 2 or 3 true leaves have developed. Both tip cuttings from vigorous, recently matured growth and air layers root when rooting hormone solutions of 2000 to 4000 ppm IBA or IBA-NAA combinations are used. The difficult-to-root forms may benefit from higher concentrations of auxin as Tanabe and Frazier (1985) found 3% IBA in talc dusts improved both percent rooting and root quality of air-layered ohia.

The native *Pittosporum* species (*P. confertiflorum*, *P. floculosum*, and *P. hosmeri*) are dense, slow-growing, handsome broad-leaved evergreens. They are not used much because of the difficulty of obtaining plants, but they offer one of the challenges to the Hawaii nursery industry. Seed takes 6 or more months to germinate (NTBG, 1996), and it is not clear that the recommended scarification and soaking treatments are particularly helpful. Cutting propagation has, to this point, yielded low percentages of success with tip cuttings and 4000 to 6000 ppm auxin.

Another challenge to the Hawaii nursery industry is alahe'e, *Psydrax odorata* (syn. *Canthium odoratum*). A small shrub or tree found in the dry mountains and exposed coastal slopes, alahe'e produces glossy dark-green leaves on a densely branched plant. Its tiny white flowers are fragrant. Seed propagation is a preferred method of propagation, but the larvae of a tiny moth attack the seeds and fewer than 10% are viable. Germination takes 30 to 180 days and both cold storage and presoaking the seed in water for 24 h have been recommended (NTBG, 1996). At the University of Hawaii, we have had some success in rooting greenwood cuttings under high humidity. The use of 4000 ppm IBA has worked about as well as any other treatment, but rooting percentages have not been high, about 10%. We have also tried the phenylthioester of IBA at 5000 and 10000 ppm with no improvement over the lower IBA treatment.

Many Hawaiian plants with ornamental potential remain a challenge to the nursery industry. A more than 20-year-old challenge to germinate the seed of pukiawe (*Styphelia tameiameia*) (Woolliams, 1975) has been met by Alvin Yoshinaga, a researcher at the Harold Lyon Arboretum, and by a demonstration of culturing seed aseptically by one of our graduate students, Ted Radovich. Still, neither would claim that their work is the basis for commercial propagation. We looked for evidence of an immature embryo by slicing the seed on a microtome and found that the embryo was already developed when the fruit was harvested.

LITERATURE CITED

- Bornhorst, H.L.** 1996. Growing native Hawaiian plants. Bess Press, Honolulu.
- Bornhorst, H.L.** and **F.D. Rauch.** 1994. Native Hawaiian plants for landscaping, conservation, and reforestation. Univ. Hawaii, HITAHR Res.-Ext. Ser. 142 (rev.).
- Crivellone, C.F.** 1991. Hinahina for use as a landscape groundcover. 1989 Hawaii Nursery Research, Rauch, F. D. (Ed.) Univ. Hawaii, CTAHR, HITAHR Res.-Ext. Ser. 126:13-14.
- Crivellone, C.F.** and **F.D. Rauch.** 1991. The use of indolebutyric acid (IBA) on the rooting of hinahina. 1989 Hawaii Nursery Research, Rauch, F. D. (Ed.) Univ. Hawaii, CTAHR, HITAHR Res.-Ext. Ser. 126:14-15.
- Koob, G.A.** 1998a. 'Ahinahina. Hawaii Hort. 1(5):3-5.
- Koob, G.A.** 1998b. Pohinahina. Hawaii Hort. 1(9):3-5.
- Matsuda, T.K.** and **R.A. Criley.** 1980. Rooting response of *Wikstroemia uva-ursi* to various root-promoting substances. Hort. Digest (Hawaii) 55:2-3.
- McEwen, J.** 1995. Unpublished papers on the propagation of akia, *Wikstroemia uva-ursi*. M.S. Plan B, Department of Horticulture, University of Hawaii at Manoa, Honolulu, HI.
- National Tropical Botanical Gardens.** 1996. Ten native Hawaiian trees for urban landscapes. Nat. Trop. Bot. Gard.. Lawai, HI
- Rauch, F.D., H.L. Bornhorst,** and **D. Hensley.** 1993b. Ma'o (Hawaiian cotton). Univ. Hawaii, CTAHR, Coop. Ext. Serv. Orn & Flowers No. 13.

- Rauch, F.D., H.L. Bornhorst, and D. Hensley.** 1993b. 'Ilima Univ. Hawaii, CTAHR, Coop. Ext. Serv. Orn & Flowers No. 15.
- Rauch, F.D., H.L. Bornhorst, R. Stibbe, and D. Hensley.** 1995. O'ahu white hibiscus. Univ. Hawaii, CTAHR, Coop. Ext. Serv. Orn & Flowers No. 22.
- Rauch, F.D. and D. Hensley.** 1993. Wiliwili. Univ. Hawaii, CTAHR, Coop. Ext. Serv. Orn & Flowers No. 10.
- Tanabe, M.J. and B. Frazier.** 1985. The influence of auxin on the airlayering of ohia-lehua. pp. 68 - 69. In: Proc. 2nd Orn. Fert. and Orn. Short Course (1984). Rauch, F. D., W. W. McCall, and K. W. Leonhardt (Eds). Univ. Hawaii, CTAHR, HITAGR 01.04.85.
- Tokumar, C.** 1997. Unpublished papers on propagation of *Hibiscus arnottianus* var. *punaluuensis*. M. S. Plan B, Dept. of Horticulture, Univ. Hawaii at Manoa, Honolulu, HI.
- Weissich, P.R.** 1994. Hawaiian native plants in the landscape. Comb. Proc. Intl. Plant Prop. Soc. 44:332-335.
- Woolliams, K. R.** 1975. The propagation of Hawaiian endangered species. Newsl. Haw. Bot. Soc. 14:59-68.