Combined Proceedings IPPS 68:196-201. 2018.

Developing Propagation Protocols for Native Hawaiian Plants with Potential Landscape and Indoor Uses

Orville C. Baldos[a], Aleta K. Corpuz, and Darel Kenth S. Antesco
Department of Tropical Plant and Soil Sciences, University of Hawaii at Manoa, 3190 Maile Way, St. John 102, Honolulu, Hawaii USA 96822, USA

obaldos@hawaii.edu

Keywords: *Heteropogon contortus*, *Chenopodium oahuense*, *Melanthera integrifolia*, *Eragrostis deflexa*, *Jacquemontia ovaliifolia*, *Peperomia* spp.

Abstract

Native plants as ornamentals are gaining popularity across the United States, including Hawaii where native plants have been promoted since the 1990s and are required in state-funded landscaping projects. Due to limited information and to increase availability and variety of native Hawaiian plant selections, a research program was established at the University of Hawaii at Manoa to collect, select, and evaluate non-endangered and underutilized species for ornamental uses.

Research has provided useful information on propagation of *Heteropogon contortus* (pili grass), *Chenopodium oahuense* (aweoweo), *Melanthera integrifolia* (nehe), *Eragrostis deflexa* (Pacific lovegrass), *Jacquemontia ovaliifolia* (pau o hiiaka), and *Peperomia* spp. (ala ala wai nui).

INTRODUCTION

The use of native plants as ornamentals is gaining popularity in the United States. In recent years people have become more aware that plants in the landscape not only provide benefits to human needs (e.g. aesthetics and functionality), but also provide ecosystem services. The composition of plants in a landscape can have effects on wildlife, water quality, climate, soil microbiology, and other factors on the surrounding area. Due to issues such as water use/conservation, biodiversity conservation and invasive species spread,

interest in the use of native plants has increased. Besides environmental issues, the use of native plants is also encouraged because it also provides a sense of place (e.g. saguaro of the Sonoran Desert, redwoods of Northern California). A recent survey by the American Society of Landscape Architects indicate that native plants and drought tolerant plants were the top landscape/garden elements demanded by residential consumers in 2018.

NATIVE HAWAIIAN PLANTS

In Hawaii, the use of native plants in landscapes has been promoted since the 1990s. This is due to a state law requiring the use of native plants in state-funded landscaping projects. Demand for native Hawaiian plants is expected to increase in the next 20 years due to amendments to the previous state law. In the revised legislation (Act 233 (15) Relating to Hawaiian Plants), the percentage footprint of native plants in state-funded landscaping projects will be increased from 10% by 2019 to 35% by 2030. Despite active promotion to use native Hawaiian plants in landscaping, several bottlenecks still exist. Tamimi (1999) and Ricordi et al. (2014) found that availability and variety of plants as well as lack of horticultural information (e.g. care and use in landscape design) are the key limitations to maximizing the use of native Hawaiian plants in landscaping. In addition, there has been little to no research done to develop selections or nativars suitable for landscape and other ornamental uses.

SUSTAINABLE ORNAMENTAL HORTICULTURE LABORATORY AT THE UNIVERSITY OF HAWAII AT MANOA

To increase availability and variety of native Hawaiian plant selections, I (first author) established a research program to collect, select, and evaluate non-endangered and underutilized species for several ornamental uses (i.e. landscape, potted ornamental, indoor/houseplant, and floriculture use). Research on propagation comprises a big portion of our program since successful release of a native plant selection requires a well-developed propagation technique. Propagation methods that we are currently exploring are the following: 1) seed, 2) cuttings/division, and 3) tissue culture. For seed propagation, we are interested in exploring dormancy and the pretreatments necessary to relieve it. For research on cuttings/division, we would like to know if accessions vary in rooting and if rooting hormones can improve root morphology. We are also interested in developing tissue culture protocols for more difficult-to-propagate plants.

Currently, we are conducting research on native plants for landscape/potted plant use and indoor use. Species that we are studying for landscape/potted plant use are aweoweo (*Chenopodium oahuense*), ilima (*Sida fallax*), nehe (*Melanthera integrifolia*), Pacific lovegrass (*Eragrostis deflexa*), pili grass (*Heteropogon contortus*) and pau o hiiaka (*Jacquemontia ovaliifolia*). Species we are currently evaluating for indoor use are sedges (*Carex* spp.) and ala ala wai nui (*Peperomia* spp.). I would like to share some propagation experiments that we have conducted on some of these potential species.

Heteropogon contortus (pili grass)

Pili grass is an indigenous, drought tolerant, perennial grass found on all main Hawaiian Islands. It is a culturally important species since the ancient Hawaiians have used it as a thatching material for the traditional ‘hale’ (houses). In recent years, demand for pili grass has increased due to interest in building these structures with authentic plant materials. There is also interest in using pili grass for erosion control, roadside revegetation, green roofs, and urban landscaping. Upright and prostrate forms of

pili grass occur in Hawaii and can be selected for various uses. Pili grass is usually propagated from seed but can also be propagated with some success through division. Freshly harvested seeds of pili grass possess dormancy and require an after-ripening period of 1 year. Conditions to hasten or optimize the after-ripening period have not been studied before, so we looked at the influence of storage humidity (12%, 50% and 75% equilibrium RH), temperature (10°C, 20°C and 30°C) and storage period (0, 1, 3, 6, 9 and 12 months) on dormancy loss of pili grass. Results from this study indicate that the optimum conditions were storage of the seeds at 12% equilibrium RH and 30°C for 1 year (Baldos et al., 2014). With this treatment we can achieve germination percentages greater than 90%.

Aside from after-ripening, we also found that smoke water application can stimulate germination of 1-month-old seeds. I tested two known components of smoke (KAR_1 and cyanide) and found that cyanide (at the concentrations found in smoke) can break dormancy of seeds (up to 30% germination). If making smoke water is a hassle, a 1% dilution of food grade liquid smoke (tested free of cyanide) can also break seed dormancy (Baldos et al., 2015).

Chenopodium oahuense (aweoweo)

Aweoweo is an endemic, drought tolerant shrub or tree found on all main Hawaiian Islands. It has been used by ancient Hawaiians for medicinal purposes and as a famine food. Aweoweo growth forms are diverse, ranging from prostrate (occurring on the coast) to shrub/tree form. This diversity in growth forms can allow selections for various ornamental uses. Aweoweo can be propagated from seeds or through stem cuttings. We currently have two selections of prostrate aweoweo that we are evaluating for potted and landscape use. One question that we wanted to know about these selections was its rooting response with or without application of rooting hormone. We did a rooting experiment comparing the two selections with or without 3,000 ppm of indolebutyric acid (Hormex 3). Results of the experiment indicated that the two accessions are easy and fast to root (>90% rooting within 23 days). Rooting hormone application did not improve percent rooting, rooting index (visual scale of root density), or length of the longest root. There was a significant difference in longest root length between selections with the compact selection having longer roots than the prostrate selection.

Melanthera integrifolia (nehe)

Nehe is an endemic coastal perennial herb found on all main Hawaiian Islands. Flowers and fruits of nehe are used in lei making. It has been promoted as a groundcover for landscapes but is still not used as widely. A recent collection trip has shown that there is substantial variation in leaf shapes and growth of nehe. This provides the potential to select plants suitable for potted/hanging baskets and landscape use. Propagation of nehe can be easily done through stem cuttings with no rooting hormone required. Due to the variations found in our collection, we wanted to characterize rooting of the different accessions. We also wanted to find out if accessions will benefit from rooting hormone application (despite what the literature mentions).

We studied rooting behavior of three accessions (Koko Head, Makapuu, and Southpoint) treated with or without 3,000 ppm indolebutyric acid. Results of the study indicated that nehe is easy to root (>90% rooting). There were differences in root surface area of accessions: Makapuu exhibited the highest root surface area, followed by Koko Head (intermediate) and Southpoint (lowest root surface area). Contrary to what

the literature mentions, rooting hormone application improved root morphology of cuttings (i.e., root surface area, number of root tips, and total root length), regardless of accession. This new information may be beneficial for improving root morphology of accessions such as Southpoint (with low root surface area).

Eragrostis deflexa (Pacific lovegrass)

Pacific lovegrass is an endemic bunchgrass found in the dry, leeward forests of Lanai and Hawaii Islands. Its upright growth and linear leaves make it a potential landscape accent or groundcover. It is a rare grass with very limited information about its propagation. Typically, it is propagated from seeds. Since success in propagation through division is not known, we did some experiments to evaluate survival and rooting of bare rooted clumps combined with the application of rooting hormone (as a soak). For our soak treatments, we compared non-soaked (control) clumps with soaked clumps in tap water, 1:20 Dip 'N Grow® (500 ppm indolebutyric acid + 250 ppm naphthalene-acetic acid) and 1:10 Dip 'N Grow® (1,000 ppm indolebutyric acid + 500 ppm naphthaleneacetic acid). Results of the soaking study indicated that soaking was detrimental to the plant (100% mortality). Non-soaked, control plants displayed moderate success (70% with new roots and shoots). Based on the results, seeds are still the best way to propagate this species.

Jacquemontia ovaliifolia (pau o hiiaka)

Pau o hiiaka is an endemic, coastal vine found on all main Hawaiian Islands. It has been used by the early Hawaiians for medicinal purposes. It has been promoted for use as a native groundcover in landscaping and has potential use as a container/hanging basket plant. Our germplasm collection of pau o hiiaka shows differences in flower color, leaf size, hairiness, and branching habit. This diversity in characteristics allow selection for various ornamental purposes. Propagation of pau o hiiaka can be easily done from cuttings. We wanted to characterize rooting of each accession, so we compared rooting of 1-node and 4-node cuttings with preformed roots. Results of the study indicate that certain accessions exhibited differences in rooting character-istics. The Southpoint and McGregor Point (hairy) accessions exhibited shorter roots than the other accessions (Puhala Bay, Ahihi-Kinau, Lyon Arboretum, Shidler Business School) tested. The use of 4-node cuttings was superior to 1-node cuttings as the former had more roots and higher rooting percentages (97% for 4-node vs. 73% for 1-node cuttings). Based on the results of the study, a minimum of 4-nodes on cuttings is recommend for propagating pau o hiiaka.

Peperomia spp. (ala ala wai nui)

Ala ala wai nui are succulent herbs found growing in dry to wet forests on most main islands (except Kahoolawe). Of approximately 1000 species found worldwide, about 25 species (2 native and 23 endemic) are found in Hawaii. Our collections of species show varying leaf shapes and colors. This allows selection for houseplant use. We have trialed four species (*P. blanda*, *P. cookiana*, *P. oahuense*, and *P. sandwicense*) for tolerance under low light levels. Results of the study indicate *P. sandwicensis* as the species with the most potential for indoor use.

To complement our indoor trials, we also conducted studies to explore the potential of whole-leaf cuttings as a plant material for propagation. Leaf cuttings of *P. blanda*, *P. cookiana*, *P. oahuensis*, and *P. sandwicense* were treated with or without 1,000 ppm indolebutyric acid and allowed to root under mist (*P. cookiana*, *P. oahuense*, and *P. sandwicense*) or sprinkler irrigation (*P. blanda*). Results of the study indicate that all species except *P. sandwicensis* were fairly successful (>84% rooting) with propagation from leaf cuttings. Application of rooting hormone did not improve rooting, except for *P. oahuense* (rooting hormone application

increased root length). The low rooting percentage of *P. sandwicensis* may be due to excessively wet conditions. Testing under dry conditions is recommended.

TISSUE CULTURE

Aside from seed and cutting propagation, our lab is also looking at tissue culture as a means to mass propagate select species, such as ala ala wai nui. One of the initial hurdles to successful tissue culture is finding the right sterilization technique. It may be difficult for ala ala wai nui since most of the species have fine hairs. A preliminary study on sterilization and tissue culture of *P. sandwicensis* has shown some success. However, more detailed studies are required to refine the technique.

SUMMARY

Based on our experiences, we can say that exploration of propagation protocols is an essential step to introducing new ornamental native plant selections. Our studies have shown that there is no one-size-fits-all method. Different species have different propagation challenges. Ease of propagation can be dependent on species and vary among selections. Hormone application may be beneficial, even for easy-to-root species.

Literature Cited

Baldos, O.C., DeFrank, J., Kramer, M., and Sakamoto, G.S. 2014. Storage humidity and temperature affect dormancy loss and viability of tanglehead (*Heteropogon contortus*) seeds. HortScience *49*:1328-1334.

Baldos, O.C., DeFrank, J., and Sakamoto, G.S. 2015. Germination response of dormant tanglehead (*Heteropogon contortus*) seeds to smoke-infused water and the smoke associated stimulatory compounds, karrikinolide and cyanide. HortScience *50*:421-429.

Additional resources

Abbott, I.A. 1992. La'au Hawai'i: Traditional Hawaiian Uses of Plants. Honolulu (HI): Bishop Museum Press., p. 99-102.

Bornhorst, H.L. 2005. Growing Native Hawaiian Plants: A How-to Guide for the Gardener. Honolulu (HI): Bess Press, p. 25-26.

Elliot, D.D. and Tamashiro, S.Y. 2009. Native Plants Hawai'i Project. URL: <http://nativeplants.hawaii.edu/> (accessed 25 June 2018). Honolulu (HI): University of Hawaii.

Ricordi, A.H., Kaufman, A.J., Cox, L.J., Criley, R., and Cheah, K.T. 2014. Going native in Hawai‘i. Landscape J. *33*(2):127-139.

Tamimi, L.N. 1999. The use of native Hawaiian plants by landscape architects in Hawaii [MLA thesis]. Blacksburg (VA): Virginia Polytechnic Institute and State University.

Herring, E. 2001. Hawaiian Native Plant Propagation Database. https://www.ctahr.hawaii.edu/hawnprop/plants/pep-lept.htm (accessed 25 June 2018). Honolulu (HI): College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa.

Lilleeng-Rosenberger, K.E. 2005. Growing Hawai'i's Native Plants: A Simple Step-by-Step Approach for Every Species. Honolulu (HI): Mutual Publishing, p. 290-291.

Office of Hawaiian Affairs. 2015. OHA-5 HB 206/SB435 relating to Hawaiian plants. http://www.oha.org/wp-content/uploads/2015/01/OHA-5-Hawaiian-Plants-External-White-Paper-Final.pdf (accessed 25 June 2018). Honolulu (HI): Office of Hawaiian Affairs.

Wagner, W.L., Herbst, D.R., and Somer, S.H. 1999. Manual of Flowering Plants of Hawaii, revised ed. Honolulu (HI): University of Hawaii Press, p. 1029.