

Propagation Research and Teaching for Ecologically-Friendly Landscapes and Gardens in Florida

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Summary

For nearly two decades plant propagation has been central to the authors research and educational programs. Recently, a course in plant propagation was used to evaluate perceived student knowledge gains of 17 core subject areas before and after using a mobile application called PropG (<https://propg.ifas.ufl.edu>). Results revealed PropG to be a valuable tool in learning propagation concepts and terms, with an average knowledge gain of 52%. In addition to launching tools to facilitate plant propagation education, a series of propagation and production research studies have been conducted over the years to: 1) evaluate the fertility and landscape performance of cultivars and/or hybrids of ornamental invasives and 2) develop reliable propagation systems of novel or underutilized natives having ornamental and ecological value. Attractive, fruitless selections of

highly popular species such as butterfly bush (*Buddleja* sp.), heavenly bamboo (*Nandina domestica*), Mexican petunia (*Ruellia simplex*), lantana (*Lantana strigocamara*), trailing lantana (*Lantana montevidensis*), privet (*Ligustrum* sp.), maiden silvergrass (*Miscanthus* sp.) and fountain grass (*Pennisetum* sp.) have been identified as suitable non-native alternatives to the invasive or potentially invasive resident taxa. Also, as alternatives to ornamental invaders, over a dozen native species have been studied to determine their optimal propagation by seeds, cuttings, and/or micropropagation, as well as their performance in statewide landscape trials. Promising results are hoped to facilitate their increased availability and wider use in landscapes and gardens of Florida and other warm climates.

TEACHING AND RESEARCH

HIGHLIGHTS

Innovative propagation teaching tool.

The study of plant propagation requires a working knowledge of a significant number of terms and concepts. With this in mind, the ninth edition of *Hartmann and Kester's Plant Propagation: Principles and Practices* was updated to include a compiled glossary of nearly 500 propagation terms as a separate section following the subject matter chapters (Davies et al., 2018). The ability to readily retrieve these terms in the 1,000-page textbook at any time or place was not achievable until recently. PropG, a

mobile and desktop application (<https://propg.ifas.ufl.edu>), was developed as a collaborate effort between the universities of Florida, Kentucky, and Texas A & M as a universal resource for readily accessing propagation-related glossary terms and corresponding graphics and videos. Organization of these terms began with nine categories including: 1) Biology of propagation, 2) Propagation environment, 3) Genetic selection, 4) Seed propagation, 5) Cutting propagation, 6) Budding and grafting, 7) Bulbs and other geophytes, 8) Layering and division, and 9) Tissue culture and micropropagation (Fig. 1).

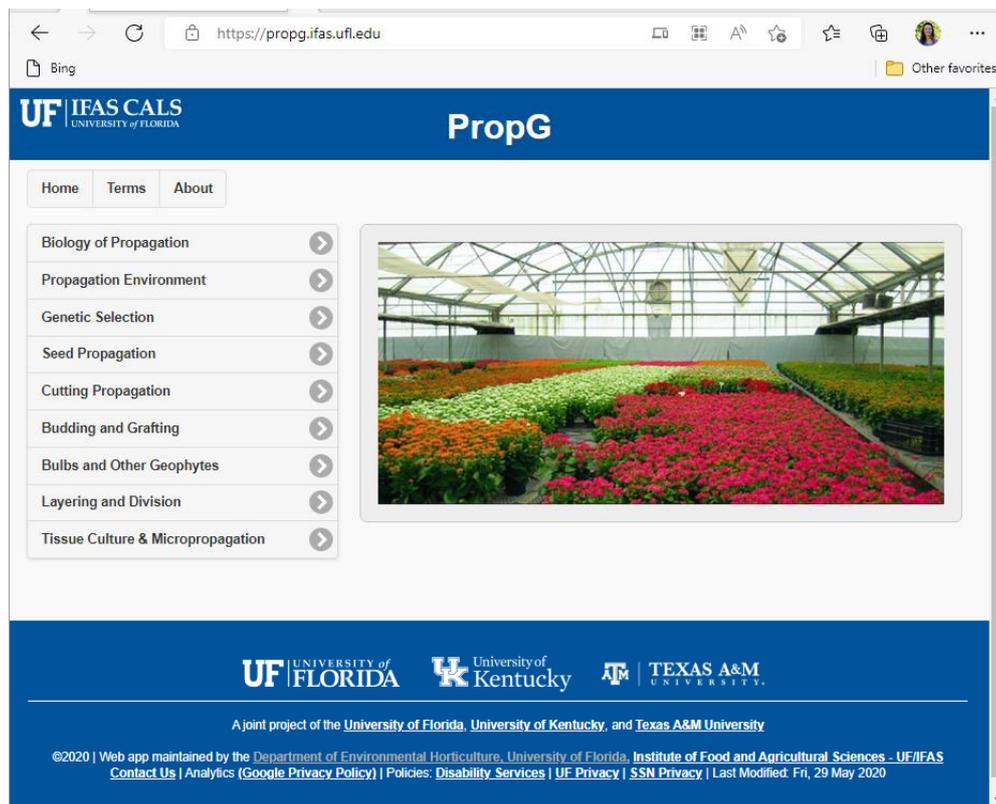


Figure 1. Screenshot of the front page of the mobile application (PropG) built using JQuery software (Mountain View, CA). Users can first select from these nine subject areas within the PropG navigational menu (<https://propg.ifas.ufl.edu>).

Each of these categories were then further divided into additional drop down menu options providing conceptual descriptors of

over 1262 images. Since inception in 2021, PropG has been widely used and is gaining momentum. To date, PropG has received

136,339 original page views from over 43 countries. Further, it has been found to more than double student's perceived knowledge of each of 17 core subject areas tested before and after its use within a single semester (Wilson et al., 2023).

Evaluation of non-fruiting cultivars of popular ornamental invasive plants. Ornamental horticulture has been recognized as the fastest growing segment of U.S. Agriculture, as well as the main source of plant invasions worldwide. In the past two decades in Florida, tremendous advances have

been made to identify and/or select non-invasive forms of a number of popular ornamental species such as privet (*Ligustrum* sp.), fountain grass (*Pennisetum setaceum*), heavenly bamboo (*Nandina domestica*), lantana (*Lantana camara*), maiden silvergrass (*Miscanthus sinensis*), butterfly bush (*Buddleja* sp.) Mexican petunia (*Ruellia simplex*), porterweed (*Stachytarpheta* sp.), and trailing lantana (*Lantana montevidensis*). As a result of these efforts, the invasive wild type forms are gradually being replaced with newer non-invasive, UF IFAS-approved cultivars that are superior in flowering and performance (**Table 1**).

Table 1. List of popular ornamental species in Florida along with their current ranking by the Florida Invasive Species Council (FISC) and University of Florida *Assessment of Non-native Plants* for north (N), central (C), or south (S) Florida (UF/IFAS AS, 2022). As potential non-invasive alternatives, selections with little or no fruiting are listed based on research trials. Species marked with an asterisk (*) were additionally subjected to the IFAS/AS Intraspecific Taxon Protocol plant use recommendations. Further morphological and cytological detail for each species can be obtained by downloading research publications from the authors website (https://irrecenvhort.ifas.ufl.edu/invasive_pub.html).

Species	Invasive ranking	Non-invasive selections (low to no fruiting) (https://irrecenvhort.ifas.ufl.edu/invasive_pub.html)
<i>Buddleja lindleyana</i>	FISC- not listed IFAS/AS- not a problem species N,C,S	<i>B. × weyeriana</i> × <i>B. lindleyana</i> ‘Violet Eyes’; also, <i>B. × weyeriana</i> ‘Honeycomb’, ‘Moonlight’, and ‘Sungold’
<i>Lantana strigocamara</i>	FISC- Category I IFAS/AS- invasive N, C, S	*T2, T3, T4, T9, Bloomify Rose, Bloomify Red, Lucious Royal Red Zone
<i>Lantana montevidensis</i>	FISC- not listed IFAS/AS- high invasion risk	U.S. varieties had little to no fruiting and were triploid, while the Australian form was tetraploid.
<i>Ligustrum japonicum</i>	FISC- not listed IFAS/AS- high invasive risk N,C,S	‘Howard’, ‘Jack Frost’, ‘Lake Tresca’, ‘Rotundifolium’, ‘Texanum’, ‘Davidson’ (all had little to no fruiting in south Florida)

<i>Ligustrum lucidum</i>	FISC- Category I IFAS/AS -use with caution to prevent escape, N,C,S	No fruit observed in south Florida
<i>Ligustrum sinense</i>	FLDACS- noxious weed FISC- Category I IFAS/AS- invasive N, C, S	‘Sunshine’, ‘Swift Creek’
<i>Miscanthus sinensis</i>	FISC-not listed IFAS/AS- not a problem species N,C,S	‘Morning Light’ and ‘Puenktchen’ (south FL)
<i>Nandina domestica</i>	FISC- Category I IFAS/AS Invasive N,C	*‘Firepower’, ‘Gulf Stream’, ‘Harbour Dwarf’, Firestorm, ‘AKA’ Blush Pink, ‘Firehouse’, ‘Lemon-Lime’, ‘Murasaki Flirt, ‘SEIKA’ Obsession
<i>Pennisetum setaceum</i>	FISC- formerly Category II IFAS/AS- not a problem species N,C,S	‘Rubrum’
<i>Ruellia simplex</i>	FISC- Category I IFAS/AS- invasive N,C,S	*Mayan Series (pink, white, purple, compact purple), Aztec Series (pink/white, pink, purple), ‘Purple Showers’ (use caution to prevent escape)
<i>Stachytarpheta cayennensis</i>	FISC- Category II IFAS/AS-use with caution N,C,S	‘Mario Pollsa’, ‘Naples Lilac’, and ‘Violacea’

Propagation of native plants with ornamental potential and ecological value.

Florida boasts abundant richness in flora with over 3,300 native plant species, yet less than a quarter of these are in cultivation. When used correctly, native plants can naturally offer desired aesthetic attributes such as color and form, while bringing biodiversity and function for ecologically friendly landscaping. In the last two decades significant progress has been made in the propagation, production, and landscape trialing of a number of native species that are either: 1) attractive in their natural areas and have potential for the ornamental industry, or 2)

are already in limited cultivation, but merit widened use for landscapes and gardens. Propagation practices were explored to optimize production of natives by seed, cuttings, or tissue culture and to determine their landscape performance in multiple locations. These efforts helped to increase the native plant palette of Florida and identify ways for efficient, year-round production (**Table 2**). Opportunities remain for better consumer awareness, marketing and promotion of environmentally friendly plants that can offer similar form, flowering, fruiting, and growing requirements (sun, soil, moisture) as popular, non-invasive exotics.

Table 2. List of ornamental species native to Florida that merit wider use in landscapes and gardens based on landscape evaluations. Propagation systems were evaluated using seed, cuttings, or micropropagation with key findings briefly described for each species. Greater detail can be found in the associated publications downloadable from the authors website (https://irrecenvhort.ifas.ufl.edu/nativeplant_pub.html).

Common name	Species	Propagation technique https://irrecenvhort.ifas.ufl.edu/nativeplant_pub.html
Coastal plain honeycombhead	<i>Balduina angustifolia</i>	Seeds germinated under light or dark conditions and germination was influenced by temperature and population. Seeds are orthodox and retained high viability after a year of storage. Gibberellic acid improved germination of some populations. This species can be propagated by cuttings. Use of substrates with sand improved container quality of plants.
Florida scrub roseling	<i>Callisia ornata</i>	Propagation by seed is possible but vegetative propagation results in a fuller plant that performed well in the landscape trials. Plants grown in container media with a high proportion of vermiculite (low air-filled porosity) did not perform as well as other substrates tested.
Woody goldenrod	<i>Chrysoma pauciflosculosa</i>	Seeds prefer cooler alternating temperatures to germinate best. Cutting propagation is possible from softwood or hardwood cuttings. Auxin is not necessary but will improve rooting quality. Plants can grow in a variety of substrates.
Godfrey's goldenaster	<i>Chrysopsis godfreyi</i>	Optimal seed germination was in fall or winter with light. Substrates with low peat improved container production.
Feay's prairie clover	<i>Dalea feayi</i>	Seed scarification was necessary to alleviate physical dormancy. This species had very good visual quality ratings when container-grown both peat and bark-based media.
Gopher apple	<i>Geobalanus oblongifolius</i>	Seeds are nondormant preferring warm alternating temperatures for best germination. Cutting propagation is possible using softwood cuttings with auxin for best rooting.
Squareflower	<i>Paronychia erecta</i>	Seeds germinate readily to high percentages without pretreatments. Germination is promoted by exposure to light although some germination occurs in the dark. Seeds prefer moderate to cooler temperatures compared to summer. This species has been successfully propagated by cuttings and also by micropropagation.

October flower	<i>Polygonum polygamum</i>	Seeds have non-deep physiological dormancy that can be overcome by after ripening, warm stratification or application of GA. This species can be easily propagated by softwood cuttings stuck in late May.
Largeflower jointweed	<i>Polygonum nesomii</i>	Seeds have non-deep physiological dormancy. The population from where cuttings are collected may affect rooting percent and quality, with a combination of different NAA and IBA concentrations useful.
Wild coffee	<i>Psychotria nervosa</i>	In controlled studies, spring and summer temperatures were ideal for seed germination, but seeds had sporadic emergence over time. Cutting propagation is a reliable and efficient method of production, with auxin producing the high-quality root systems. A cultivar of this species is in commercial micropropagation production.
Softleaf wild coffee	<i>Psychotria tenuifolia</i>	A high proportion of cuttings can root fairly quickly with or without auxin, but auxin increases rooting response.
Bahama wild coffee	<i>Psychotria ligustrifolia</i>	Cuttings can likely be taken year-round with minimal concentrations of talc auxin.
Sweet acacia	<i>Vachellia farnesiana</i>	Seed scarification is needed prior to germination to alleviate physical dormancy. Cutting propagation is possible but not ideal. This species can be easily micropropagated using multiplication medium with BA and rooting media with IBA and NAA.
Wild lime	<i>Zanthoxylum fagara</i>	A portion of the seeds have physiological dormancy that must be overcome before germination. With proper stock management, semi-hardwood/softwood cuttings root when using moderate levels of auxin. Micropropagation has been a challenge.

CONCLUSIONS

In summary Prop-G is an effective mobile application for learning or reviewing plant propagation terms and concepts. Along with technological advances such as PropG as a novel teaching tool, significant research progress has also been made in iden-

tifying safer native and non-native alternatives to ornamental invasives and understanding their reproductive potential. Education remains key. It is hopeful that the newly released ‘Plant This not That’ guidebook of 22 invasive plant entries paired

with research-based non-invasive alternatives (McIntyre et al., 2021) will help research, teaching and extension personnel, homeowners, and industry alike to make informed decisions of future plant selection and use.

LITERATURE CITED

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