

problems and successes. Although the world is continuing to get smaller and many production methods are the same, other countries' nurseries still operate detached from our daily nursery practices. Travel to these regions offers a great chance to load up on ideas. Each region has annual meetings similar to the Eastern, Southern, and Western regions in the U.S.A. You would be welcome and the members would be honored to have you attend their meetings. You can find dates and programs on the I.P.P.S. website: <www.ipps.org>.

Characterizing Invasiveness of Ornamental Species of Florida[®]

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INTRODUCTION

The State of Florida is the second largest producer of ornamental plants in the U.S.A. with an estimated \$9.9 billion in total industry sales during 2000 (Hodges and Haydu, 2002). While most intentionally introduced species remain in their cultivated settings, some escape cultivation and invade natural areas. An invasive plant species is defined as a non-indigenous species that has the ability to establish self-sustaining, expanding populations, and may cause economic and/or environmental harm (National Invasive Species Council, 2001; Vitousek et al., 1995). Today, approximately 1.9 million acres of Florida's remaining natural areas have been invaded by exotic plant species and more than \$240 million has been spent in Florida to control invasive, exotic plant species since 1980 (FLEPPC, 2003). The Florida Exotic Pest Plant Council (FLEPPC) maintains a list of plants considered invasive in the state, each designated as Category I or Category II. Category I species are defined as invasive exotic plants that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives. Category II species are defined as invasive exotics that have increased in abundance or frequency but have not altered Florida plant communities to a significant extent. Of the 124 plant species listed as invasive (Category I or II) by the FLEPPC, it is estimated that 67% were introduced as ornamentals (FLEPPC, 2003). While the FLEPPC list contains some plants that are regulated also by state law, the list does not have statutory authority, impart because there are many different interpretations of whether a plant is invasive. Fourteen of the plants listed as Category I by FLEPPC are still cultivated extensively by the Florida Nursery and Landscape Industry for their ornamental value (Wirth et al., 2003). Some of these species have numerous cultivars of which seed production and viability is largely unknown. In addition, some species or cultivars may only be capable of invading or surviving in certain geographical regions of the state.

To address these concerns, several researchers at the University of Florida have been funded through various sources (Florida Department of Environmental Protection, United States Department of Agriculture, IFAS Invasive Plant Working Group, and Florida Nursery and Growers Association) to characterize the potential invasiveness of some highly ornamental plants (Dehgan et al., 2002; Mecca et al., 2003; Wilson and Mecca, 2003). In addition, an Institute of Food and Agricultural

Sciences (IFAS) Assessment was developed to provide criteria for determining whether a species is recommended for use in north, central, or south Florida (Fox et al., 2003). A brief description of some of the current University of Florida research projects with regards to ornamental invasive plants follows:

Buddleja davidii. This is a widely cultivated, extremely popular, flowering shrub (U.S.D.A. Hardiness Zone 5-9) with attractive foliage and a range of flower colors, some with exceptional fragrance. Unfortunately, some of the same properties that lend it as a great landscape plant (i.e., long flowering period, adaptability to a range of environmental conditions, ease of propagation, and high vigor) also predispose it as a potentially invasive woody shrub. The species *B. davidii* has escaped cultivation in 19 states and Puerto Rico (U.S.D.A. N.R.C.S., 2003) and is considered a weed in Hawaii (Staples et al., 2000), New Zealand (Kay and Smale, 1990), Australia (Csurhes and Edwards, 1998), and Great Britain (Crawley, 1987). In the U.S.A., it is considered by many as weedy, as it is commonly found along roadsides, streamsides, and other disturbed areas of its growing range. Having evaluated 50 *Buddleja* taxa for seed production and germination at Longwood Gardens (Kennett Square, Pennsylvania), Anísco and Im (2001) recommended nursery professionals to consider species other than *B. davidii*. In Florida, *B. davidii* has not escaped cultivation. It is widely used in the upper part of the state but much less common in central-southern counties. Mecca et al. (2003) conducted a study to determine how 14 *Buddleja* taxa perform in west (Milton, Zone 8b) and south (Fort Pierce, Zone 9b) Florida with relation to landscape potential and seed production. Each of the 14 cultivars evaluated produced seed in both locations. Plant growth, plant survival, visual quality, flowering, and seed production varied significantly between the two locations. In both locations, *B. davidii* × *B. davidii* 'Dartmoor', *B. ×weyeriana* 'Honeycomb' and *B. ×weyeriana* 'Sungold' had a pod : flower dry weight ratio that was 56% to 98% lower than that of other cultivars. Throughout their study (Week 4 to 24), *B. davidii* × *B. davidii* 'Dartmoor' performed extremely well at both locations, with 100% survival, 75% flower canopy, good color and form, and low seed production.

Lantana camara. This is a widely cultivated, multi-stemmed semi-woody shrub with strongly aromatic leaves and multicolored flowers. It has been promoted for ornamental use in the U.S.A. since the 1800s and noted as escaped since 1964. It has become a problematic weed in nearly 50 countries and has extensively hybridized with the Florida native *L. depressa*. There are over 100 forms, cultivars, and hybrids available with varying invasive qualities (Hammer, 1997). Dehgan et al. (2002) evaluated 62 *L. camara* cultivars. Fertility ranged from very low, less than 5%, to high more than 80%, revealing that some cultivars are nearly male sterile. Pollen fertility in *L. montevidensis* and its cultivars ranged from 1.6% to 32% with no viable seed production indicating female sterility. Dehgan recommends avoiding the use of *L. camara* cultivars such as 'Radiation', 'Pink Caprice', and 'Dwarf Pink' that have high fruit and viable seed production. Alternative cultivars that represent the least risk of becoming invasive include *L. camara* 'Sunburst' and 'New Gold', that are sterile and do not set any fruit or 'Patriot Cowboy', 'Patriot Hallelujah', and 'Yellow Trailing', that have low pollen count and low fruit/seed set.

Nandina domestica. Heavenly bamboo is an extremely popular landscape plant (U.S.D.A. Hardiness Zone 6-10) characterized by tri-pinnately compound leaves that are dark green turning blush to reddish-purple with the onset of low tempera-

tures. Terminal panicles of white flowers appear in mid to late spring and are followed in autumn by red fruit. Introduced to the U.S.A. before 1804, the species has since escaped cultivation in nine states (U.S.D.A. N.R.C.S., 2003), including Florida (five counties) (Wunderlin and Hansen, 2003). Studies have shown that *N. domestica* is invading and altering the light environment in hardwood forests in north Florida and displays substantial acclimation potential in response to change in light intensity (Cherry, 2002). *Nandina domestica* is currently listed as a Category II invasive by FLEPPC because it has not yet altered Florida plant communities to the extent shown by Category I species (FLEPPC, 2003). Data from the UF-IFAS Assessment revealed a high invasive impact for the *Nandina* species in north and central Florida and recommended use of caution if planting in south Florida (UF-IFAS, 2001). However, it is the cultivated forms of *Nandina* that are widely used for foundation plantings, borders, and massed groupings. The Raulston Arboretum houses one of the most extensive *Nandina* collections in the U.S.A. with 39 cultivars plus the species. None of the commercially available cultivars have been formally evaluated for climatic region effects on flowering and fruiting in north and south Florida. Wilson and Knox (UF-IFAS) are currently evaluating plant performance, growth, flowering, fruit production, and seed viability of the *Nandina* species and 10 cultivars planted in Quincy (Zone 8b) and Fort Pierce (Zone 9b) Florida.

Ornamental Grasses. The use of ornamental grasses in median strips, parking lot borders, and for erosion control on slopes has become increasingly popular over the years. While most serve to beautify our landscapes, some have escaped cultivation and become invasive. Of the grasses listed as invasive by FLEPPC, 9% belong to Poaceae (FLEPPC, 2003). The wild type or species form is generally deemed invasive without regard to cultivars. For example, *Pennisetum setaceum*, *P. alopecuroides*, and *Miscanthus sinensis* are considered invasive in some states, but each has numerous cultivars. Introduced to Hawaii in 1914, *P. setaceum* has since escaped cultivation in eight states (U.S.D.A. N.R.C.S., 2003) including Florida (three counties) (Wunderlin and Hansen, 2003). It is listed as invasive in California, Florida, and Arizona and as a noxious weed in Hawaii. As an extremely aggressive colonizer, it is also problematic in other parts of the world including the Canary Islands and Australia. While data suggests a high invasive potential for the wild type form, the cultivar 'Rubrum' has been reported to be a sterile hexaploid (Simpson and Bashaw, 1969). Another popular grass, *M. sinensis*, has escaped cultivation in 25 states (U.S.D.A. N.R.C.S., 2003) including Florida (one county) (Wunderlin and Hansen, 2003). It has been estimated that 50 *Miscanthus* selections have been introduced over the past 20 years (Meyer and Tchida, 1999). Due to concerns over invasive self-seeding behaviors, Meyer and Tchida (1999) examined inflorescences of 41 *Miscanthus* taxa grown in four U.S.D.A. hardiness zones (4, 5, 6, and 7) for seed set and germination. Eleven cultivars had less than 18% viable seed, including 'Morning Light', 'Variegatus', and 'Zebrinus', and appeared to represent the least risk for becoming invasive. Seed set was significantly higher in Zone 5 than in Zone 7 and many early flowering types set viable seed in Zones 4 and 5, whereas later flowering types set little seed. The wide variation between cultivars and location in Zones 4-7 warranted additional research for Zones 8 and 9. In a current study, Wilson and Knox (UF-IFAS) are evaluating plant performance, flowering, and viable seed production of 25 cultivars from five *Pennisetum* or *Miscanthus* taxa grown in Quincy (Zone 8b) and Fort Pierce (Zone 9b) Florida.

Ruellia tweediana. Mexican petunia is an herbaceous perennial (U.S.D.A. Hardiness Zone 7-9) grown for its bright colored, trumpet-shaped flowers and adaptability to wet and dry sites in full sun or shade. It commonly is sold by the ornamental industry under the synonym *R. brittoniana*. Since its introduction sometime before 1940, *R. tweediana* has naturalized in disturbed uplands and wetlands of nine states, the Virgin Islands, and Puerto Rico (U.S.D.A., N.R.C.S., 2003). In Florida, it has formed naturalized populations in 26 counties throughout the state (Wunderlin and Hansen, 2003) and has been designated as a Category I invasive due to observed ecological invasion and disruption of native plant communities (FLEPPC, 2003). The wild type form of *R. tweediana* is inferior to the cultivated forms and rarely offered for sale. There are eight known cultivars that have been selected commercially for pink, purple, or white flowers as well as tall and dwarf forms. The cultivars reportedly are weedy in cultivation with some seedlings having the typical growth form and flower color of the species (Hammer, 2002). Wilson and Mecca (2003) compared seed production and germination among cultivars and found that while several cultivars such as 'Chi Chi', 'Morado Chi', and 'Snow White' exhibited invasive qualities similar or more pronounced than that of the wild type form, the cultivar 'Purple Showers' did not produce any seed.

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