Nuisance to Invasive Ornamentals: Proceedings from the ASHS Invasive Plants Research Group 2020 Workshop

Michael A. Schnelle¹ and Lyn A. Gettys²

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Wholesalers, retailers, and end consumers should produce, sell, or grow environmentally appropriate plants in response to enhanced concerns among those seeking to protect and preserve the environment. Voluntarily acknowledging and practicing environmental stewardship, by reducing weedy to invasive plant spread, behooves all involved. The ornamentals industry is a key source of nonnative species escaping from cultivation (Lehan et al., 2013; Pysek et al., 2011; Reichard and White, 2001; van Kleunen et al., 2018), and it is thought that the ornamentals industry has introduced in excess of 50,000 species to the United States for the nursery and landscape market (Gordon and Gantz, 2008). However, based on a survey encompassing 6885 species grown by mid-Atlantic U.S. nurseries, only 4% were deemed invasive in the region served by these nurseries [Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, Washington, District of Columbia, and West Virginia (Coombs et al., 2020)]. In addition to the nursery industry, nonnative plants have been introduced to the

United States via botanical gardens and arboreta, nurseries, garden club and horticultural society seed exchanges, and the seed trade industry to meet medicinal and culinary demands, interest in personal aquaria and water gardens, and soil erosion mitigation needs (Reichard and White, 2001).

The global economic and ecological ramifications of invasive plants are thoroughly documented and have been summarized elsewhere by a number of researchers [e.g., Kettenring and Adams (2011), Pysek et al. (2012), Weidlich et al. (2020), and many others]. Invasive plants inflict harm in a number of ways, including reducing crop yields and pasture forage (Pimentel, 2009), interfering with native plant populations, and disrupting and altering hydrological processes (Pysek et al., 2012; Weidlich et al., 2020). Furthermore, invasive plants negatively impact native fauna (Fletcher et al., 2019) and have dire financial consequences. For example, invasive species (including plants, pathogens, and animals) cause damage valued at more than \$1.4 trillion globally, and economic damage from invasive plants in the United States alone is estimated to range from \$40 billion to \$120 billion annually (City of Portland Oregon, Bureau of Environmental Services, 2021; Diagne et al., 2020a, 2020b; Hanley and Roberts, 2019; Pimentel et al., 2000, 2001, 2005).

Invasive plants are often more competitive than native species for a number of reasons, including enhanced resource uptake and use efficiency (Byun et al., 2018; Holzmüller and Jose, 2009). Rapid growth and reproduction rates of invasive species are often aggressive, resulting in dense monocultures that are not typically found in their native range (Hierro et al., 2005). Nonnative species may alter their invaded environment by producing allelochemicals that hinder native plant growth and vigor, lowering

soil pH and altering nutrient cycling within the native stands (Bias et al., 2003; Callaway and Aschehoug, 2000). Phenotypic plasticity in some invasive plants enables them to tolerate a wide spectrum of environmental conditions, which expands potential sites they may invade (Richards et al., 2006); for example, fire can promote some invasive species, whereas some invasive species can promote fire (Brooks et al., 2004). Species growing outside their native range are not subject to attack by the coevolved specialist predators that keep their growth in check in their native range (i.e., enemy release hypothesis), and invasive species may be unpalatable, ignored, or subject to minimal damage from generalist enemies in their expanded territory (Keane and Crawley, 2002).

In addition to these factors, management efforts can affect the survival and establishment of invasive species. For example, some nonnative species mimic native plants, which allows them to escape detection and grow unchallenged as a result of their resemblance to desirable vegetation (Barrett, 1983; Marble and Brown, 2021). At least 263 species are reportedly resistant to herbicides, thus allowing them to survive and multiply unchecked despite attempted control measures (Heap, 2021). Current and future invasions are bolstered as a result of commercial research and development operations that are shifting away from agrichemical development and focusing on the development of genetically modified crops (Phillips, 2020).

Experts' opinions or definitions as to what constitutes an invasive plant vary widely. Mooney and Cleland (2001) described invasive species as those that are introduced to a novel environment with negative ecological, economic, or social impacts. Similarly, Reichard and White (2001) defined an invasive plant as one that has (or is likely to) spread into native flora and managed plant systems, developed self-sustaining populations, and become dominant or disruptive (or both) in those systems. It has long been assumed that most aggressive plants are invasive species and are, by definition, nonnative, because they have invaded a habitat to which they are not native. However, it is becoming clear that native species are not always "well-behaved," and that some indigenous species can be as destructive and damaging as nonnative

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¹Department of Horticulture & Landscape Architecture, Oklahoma State University, 358 Agricultural Hall, Stillwater, OK 74078

²University of Florida IFAS Fort Lauderdale Research and Education Center, 3205 College Avenue, Davie, FL 33314

This paper is an introduction to a series of papers from the workshop titled "Progress in Identification and Control of Weedy to Invasive Plants both Domestic and Abroad" that was presented during the 2020 ASHS Annual Conference, which was held virtually 10–13 Aug. 2020.

M.A.S. is the corresponding author. E-mail: mike.schnelle@okstate.edu.

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species. For example, a number of mostly recent reports (e.g., Anderson, 2019; Anderson et al., 2021; Gettys, 2019; Marble, 2018; Reichard and White, 2001; Robertson et al., 2020; Ruter, 2019; Schnelle, 2019; Simberloff et al., 2012) acknowledge that native plant species can also exhibit behavior that ranges from weedy to invasive in nature and in cultivated settings. Also, there are conflicting opinions on how to categorize native plants that are nuisances vs. those that are actually invasive—in other words, do they have the potential simply to be an inconvenience or annoyance, or are they displacing other native flora and/or fauna and disrupting ecological processes? Given these diverse points of view, an impasse exists in reaching a consensus on what constitutes an “invasive” plant and how to mitigate invasions. A variety of terms have been proposed to describe plants with aggressive growth regardless of nativity (e.g., Colautti and Richardson, 2009; Pysek et al., 2004; Richardson et al., 2008; Warren, 2007). Iannone et al. (2020) suggest seven terms (native, nonnative, introduced, established, invasive, nuisance, and range change) that can be used to describe any species; these terms are intuitive and easily understood, which should increase understanding and thus promote behavioral changes that support efforts to mitigate the negative impacts of invasive species.

Regardless of semantics, various plans have been proposed to discourage or “police” introductions of harmful nonnative species. For example, Barbier et al. (2013) suggested that an annual license fee paid by the industry would reduce the risk of potentially dangerous introductions while raising funds for research, screening imported species, and promoting the education and eradication of existing invasive populations. In contrast, Cordeiro et al. (2020) proposed targeting consumers by providing them with information about invasive plants, which could reduce or prevent introductions and bolster support for control interventions.

The Invasive Plants Research Professional Interest Group of the American Society for Horticultural Science (ASHS) developed and executed a workshop at the 2020 ASHS annual conference to explore, debate, and mitigate this widespread dilemma

of plants with invasive tendencies. The objective of this workshop, titled “Progress in Identification and Control of Weedy to Invasive Plants both Domestic and Abroad,” was to highlight species known to be occasionally problematic and to discuss prudent corrective measures that can be taken to reduce their negative effects on the environment. Given the controversy and ongoing debate among scientists regarding invasive plants, coordinators M.A. Schnelle and L.A. Gettys invited speakers to describe troublesome species and practical approaches to mitigating their ecological and financial ramifications. Schnelle provided introductory remarks and then proceeded to deliver the first presentation, “Native Species that Merit Active Surveillance.” Schnelle highlighted a number of herbaceous and woody ornamentals, all native to the United States, that reportedly can be nuisances or even invasive in nature, depending upon local environmental conditions and cultural practices. N.O. Anderson spoke about invasive reed canarygrass (*Phalaris arundinacea*) and discussed recent research findings that the species is actually native, although previously deemed exotic. Given that reed canarygrass is often indigenous to the midwestern region of the United States, this revelation affects land managers’ and legislators’ actions and decisions going forward. S.B. Wilson followed with a review of heavenly bamboo (*Nandina domestica*), which has escaped cultivation in eight southeastern U.S. states. She provided viable alternatives, including low- or nonfruiting cultivars, that can be substituted for more aggressive heavenly bamboo taxa. Chemical control options for two introduced ornamentals, lesser celandine (*Ficaria verna*) and dwarf fountain grass (*Pennisetum alopecuroides*), were outlined by the next speaker, M. Taylor. The last presentation was delivered by S.C. Marble, who outlined characteristics that can be used to distinguish a collection of invasive plants in Florida from native plants with similar appearances. Marble provided not only identification tips, but also control strategies for plants that are deemed invasive. The workshop concluded with an open discussion and roundtable, during which speakers fielded diverse questions from workshop participants; topics included chemical and cultural control measures, breeding efforts, and strategies that can be used to educate academics, green

industry leaders and, ultimately, end-user clientele on combating weedy to invasive plants regardless of their origins. This workshop provided attendees with timely and practical information on basic principles, tenets, and management practices that could be tailored to suit their specific needs and respective geographic region.

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