



Evaluation of Heavenly Bamboo (*Nandina domestica*) Cultivars as Potential Candidates for Sterility and Landscape Use

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Abstract: *Nandina domestica* is a widely cultivated and highly ornamental species of economic importance to the nursery and landscape industries. The wild type form is listed by many organizations as being invasive in most southeastern U.S. states. A number of genetic approaches have been proposed for producing non-invasive cultivars, including development of sterile cultivars by triploidy. Identifying or developing non-invasive cultivars of *Nandina* is crucial for continued production and use. We evaluated ploidy of 40 cultivars and the wild type selection and found all are diploid. Based on these results, it is necessary to induce polyploids in order to develop sterile *Nandina*.

Introduction: *Nandina* is a widely cultivated and highly ornamental species of economic importance. The wild type form is listed by many organizations as being invasive in most southeastern U.S. states and has been recorded in natural areas of nine states (USDA NRCS, 2006). To address this issue and identify non-invasive selections, ten *Nandina* cultivars and the wild type form were evaluated in north and south Florida for landscape performance, fruiting, and seed viability (Knox and Wilson, 2006). Research showed that cultivars such as 'Monum' (Plum Passion®) and 'Compacta' perform well in the landscape but set considerable fruit containing viable seed. 'Filamentosa' and 'Firepower' failed to flower or fruit and other cultivars such as 'Gulf Stream', 'Jaytee' (Harbour Belle®), and 'Harbour Dwarf' had above average visual quality rankings and little or no fruit production. Seed viability was fairly consistent among cultivars, ranging from 73% to 86%.

A number of genetic approaches have been proposed for producing non-invasive cultivars, including rigorous selection against traits associated with invasiveness, or development of sterile cultivars. Some existing cultivars are inherently less fruitful (Knox and Wilson, 2006) and evaluation of other existing cultivars is necessary to determine if additional cultivars have less invasive qualities, so as to give growers and landscapers more options for alternative cultivars.

Furthermore, determination of ploidy number among cultivars is necessary for understanding the genetic cause of sterility in some cultivars and qualifying subsequent breeding efforts. Several genetic mechanisms such as triploidy, chromosome structural re-arrangement, or incompatibility could cause sterility. Triploidy is a common strategy for developing sterile selections whereby a diploid plant and tetraploid plant are hybridized, resulting in a sterile triploid plant. So far, the most effective approach to sterilize invasive plants has been through a breeding process using a genetic technique to produce triploids (3x). Normally plants including nursery and landscape crops are diploids (2x) with two sets of chromosomes (carriers of genes or DNA). Through chemical treatments, the number of set of chromosomes can be doubled to produce tetraploids (4x) with four sets of chromosomes. Tetraploids cross-pollinated with diploids will produce triploids (3x), which are frequently highly sterile, producing no or few seeds and no viable pollen. Tetraploids are required for triploid production. In some crops or cultivars, natural tetraploids may already exist. The objectives of this project were to (1) build on our existing knowledge of cultivar performance, and (2) devise effective approaches for sterilizing invasive cultivars.

Materials and Methods: The JC Raulston Arboretum houses one of the most extensive *Nandina domestica* collections in the U.S with 39 cultivars plus the species (Roethling et al., 2003). Tissue samples from the *Nandina* collection at JC Raulston Arboretum were collected and combined with samples gathered at the University of Florida/IFAS North Florida Research and Education Center (NFREC) (Table 1). For each sample, 40 leaflets or shoot tips from new growth were collected for use in ploidy analysis.

Flow cytometry was used for ploidy identification. Each tissue sample (~50 milligrams) was chopped thoroughly using a sharp razor blade in Cystain UV Precise reagent solution (Partec, Germany). The homogenate was incubated for one minute and then filtered through a Partec 30 um Cell-Tric disposable filter. Then the staining buffer (HR-B, Partec, Germany) was added to the suspension of nuclei and the samples were analyzed on the PA-1 ploidy analyzer (Partec, Germany) following the manufacturer's recommendations. To facilitate identification of tetraploids or triploids, small pieces of leaf from wild type diploid *Nandina* was included and analyzed as a reference.

Results and Discussion: Additional *Nandina* selections for long-term evaluation of growth and fruiting characteristics include cultivars, 'Firestorm'[™], 'Gulf Stream', 'Harbour Dwarf', 'Leucocarpa', 'Moyer's Red', and 'Monfar' (Sienna Sunrise[™]), as well as a contorted selection and the typical wild type selection. These taxa will be evaluated in north (NFREC) and south Florida (Indian River Research and Education Center) for several years to obtain data on growth, fruiting and seed viability. Cultivars shown to produce no or few fruit could be promoted as less invasive than wild type plants.

In total, 48 leaf tissue samples were collected and analyzed for ploidy levels at GCREC. Samples from all cultivars, selections and wild type plants showed all taxa are diploid. Based on these results, it is necessary to induce/produce polyploids in order to develop sterile *Nandina* via triploidy.

Acknowledgement: Special thanks to Dr. Denny Werner, Director, and staff at the JC Raulston Arboretum, North Carolina State University, Raleigh, NC, for collecting and contributing tissue samples for analysis.

Literature Cited:

Knox, G.W. and S.B. Wilson. 2006. Evaluating north and south Florida landscape performance and fruiting of ten cultivars and a wildtype selection of *Nandina domestica*, a potentially invasive shrub. *Journal of Environmental Horticulture* 24:137-142.

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Table 1. Cultivars and selections of *Nandina domestica* evaluated for ploidy level including source of samples. One sample of each was collected and analyzed unless otherwise indicated by footnotes.

Cultivar or Selection	Source ^z
(aphyllous)	JCRA
(twisted leaves)	JCRA

Cultivar or Selection	Source^z
(wild type) ^y	NFREC
'Akame'	JCRA
'Aobo'	JCRA
'Aome'	JCRA
'Atropurpurea Nana'	NFREC
'Aurea' ^x	JCRA
'Chidori'	JCRA
'Compacta'	JCRA
'Enba Zuru'	JCRA
'Firepower'	JCRA
'Greray' Sunray®	JCRA
'Gulf Stream' TM	JCRA
'Harbour Dwarf'	JCRA
'Iwai Zuru'	JCRA
'Jaytee' Harbor Belle TM	JCRA
'Kurijuse'	JCRA
'Leucocarpa'	NFREC
'Leucocarpa' ^w	JCRA
'Little Princess'	JCRA
'Monfar' Sienna Sunrise TM	JCRA
'Monum' Plum Passion®	JCRA
'Moon Bay' TM	JCRA
'Moyer's Red'	JCRA
'Nana'	JCRA
'Nana Purpurea' ^w	JCRA
'Okame' ^w	JCRA

Cultivar or Selection	Source^z
'Ori Zuru'	JCRA
'Pygmaea'	JCRA
'Royal Princess'	JCRA
'Senbazuru'	JCRA
'Shirochirimen'	JCRA
'Soga Ikada'	JCRA
'Southern Lace' ^w	JCRA
'Tancho'	JCRA
'Towne and Country'	JCRA
'Umpqua Chief'	JCRA
'Umpqua Princess'	JCRA
'Umpqua Warrior'	JCRA
'Variegata'	JCRA
'Wood's Dwarf'	JCRA

^zSource: JCRA = JC Raulston Arboretum, North Carolina State University, Raleigh, NC; NFREC = University of Florida/IFAS North Florida Research and Education Center, Quincy, FL.

^yNumber of samples = 4.

^xNumber of samples = 2.

^wNumber of samples = 3.