The New England Invasive Plant Center©

Mark Brand
Department of Plant Science and Landscape Architecture, University of Connecticut, Storrs, Connecticut 06269-4067
Email: Mark.Brand@uconn.edu

INTRODUCTION

The New England Invasive Plant Center was initiated in 2006 through a grant from USDA CSREES (Cooperative State Research, Education, and Extension Service). The University of Connecticut (UConn), the University of Vermont (UVM) and the University of Maine (UMaine) have established a multi-state, interdisciplinary program to develop novel and effective technologies to address problems caused by invasive plants that are economically and environmentally damaging to New England and to the nation as a whole. The Center faculty and staff provide expertise in the areas of horticulture, plant breeding, plant biotechnology, plant ecology, plant physiology, plant biochemistry, agricultural economics, and extension education. The main objectives of the Center are: (1) Development of non-invasive sterile landscape plants; (2) Assessment of the economic impact of invasive species in New England; (3) Development of alternative native crops; and (4) Public education and outreach. More information on the New England Invasive Plant Center can be accessed at: <www. invasivecenter.uconn.edu>.

INVASIVE SHRUB CULTIVAR EXEMPTIONS

As a first step in moving the nursery industry away from the production of invasive ornamental plants, the Center has focused a significant effort on determining if there are meaningful differences in seed production among cultivars of certain invasive species of high economic value. Generally, invasive plant bans have been made at the species level and have included all genotypes, including horticultural forms of the species. Frequently cultivars appear to be significantly different from the species in the manner in which they grow and reproduce. If some cultivars of an invasive species are less reproductively potent than the species, there may be opportunities to create specific cultivar exemptions to plant bans.

We have studied *Berberis thunbergii* and *Euonymus alatus* cultivars to determine if cultivars vary substantially from the species in their seed production. In addition we have compared the seed production of *Buddleja* Lo & Behold® 'Blue Chip' PP #19991 to other standard cultivars to determine its relative seed production. So far, this line of research has resulted in the Connecticut Nursery and Landscape Association successfully establishing a voluntary ban on 25 highly prolific barberry cultivars. The voluntary ban precluded a legislative ban on all barberries and allowed the continued use of some of the more important barberry cultivars for the nursery industry. The 'Blue Chip' butterfly bush data was instrumental in helping to get a cultivar exemption amendment put in place in Oregon's *B. davidii* ban.

DEVELOPMENT OF STERILE FORMS OF INVASIVE SHRUBS

Efforts here have been focused on developing sterile *B. thunbergii*, *B. davidii*, and *E. alatus*. Because *E. alatus* has endospermic seeds, the approach with this species has been to isolate 3n endosperm from seeds and grow triploid callus. Shoot organogenesis can be achieved and then triploid shoots can be rooted, acclimated and grown out for evaluation of horticultural and sterility characteristics. We currently have triploid plantlets of *E. alatus* that are being grown on for evaluation. For barberry, the approach has been to create 4n tetraploid plants using mitotic poisons. The tetraploid plants could then be crossed to 2n diploid plants to create 3n triploid plants that should be sterile. Numerous tetraploid barberries have been produced in both purple-leaved and yellow-leaved plants. To date, tetraploid barberries we have created have exhibited very low fertility, in comparison to diploid controls, or sterility. *B. davidii* is a natural tetraploid (4n), so in order to make crosses to create potentially sterile triploids, our plan was to produce dihaploids (2n) that could be backcrossed to standard tetraploid butterfly bushes. We successfully created dihaploid *Buddleja* by using irradiated pollen to trigger seed development from unfertilized eggs. The dihaploid plants have proven to be completely pollen and egg sterile, so for breeding purposes they represent a dead end. We are still evaluating the plants to determine if they have any horticultural value "as is" as sterile butterfly bushes.

NATIVE SHRUB EVALUATION AND DEVELOPMENT

One aspect of this work is to evaluate native shrubs for use in challenging landscape situations where invasive shrubs, such as Japanese barberry and winged euonymus, have been used. The emphasis is on native shrub species that are currently "not on the radar screen" and for which little information exists about suitability for use in difficult landscape conditions. Species under evaluation are planted in large replicated experiments in parking lot islands, along with barberry and euonymus, and are studied for a minimum of 3 years to evaluate establishment and durability of a few seasons.

Some native shrubs are studied in a more specific way. For example*, Physocarpus opulifolius* has recently experienced a dramatic increase in popularity due to the development of purple-leaved and yellow-leaved cultivars. With increased use, came increased disease problems and powdery mildew is now recognized as a significant limitation for *Physocarpus*. Using replicated and controlled studies we were able to determine that substantial differences exist among ninebark cultivars for resistance to powery mildew infection. Specific recommendations can be made regarding which purple, yellow, and green cultivars are the most resistant to mildew. Furthermore, we were able to recommend specific germplasm that should be used by plant breeders who are attempting to breed mildew-resistant, compact, purple-leaved cultivars.

Our native shrub breeding has targeted *Aronia* as a genus of interest because it produces showy flowers, colorful fruit, and excellent fall color, all on a plant that exhibits wide adapability. We believe that a solid breeding program is most easily achieved when there is access to a large and diverse germplasm base. To achieve this, we have collected over 150 accessions of *A. arbutifolia*, *A. melanocarpa,* and *A.* ×*purpurea* from as far south as Texas, Alabama, and Florida, and as far north as Ontario (Canada), Minnesota, Wisconsin, and Maine. We have also collected diploid, tetraploid, and triploid forms of the various species. When possible, seed collections have been added to the National Germplasm collection in Ames, Iowa. Initial crosses using some of the unique germplasm we have collected appears to have yielded attractive, compact forms of *Aronia* that would make this plant more appealing as a landscape plant.

ECOLOGICAL RESEARCH

One of the questions that we have been trying to answer is "where are specific invasive shrub species most likely to invade." Using demographic modeling, our ecologists have been able to suggest where plants such as winged euonymus, Japanese barberry, and oriental bittersweet are most likely to spread to over the next decades. We are also attempting to use similar demographic models to get a better handle on the consequences of using specific landscape cultivars of barberry that produce limited amounts of fruits.

Amplified fragment length polymorphism (AFLP) fingerprinting has been used to determine to what degree purple-leaved barberry genetics have integrated into populations of invasive barberry found in New England. While it was possible to find wild plants that must have crossed with, or originated from purple barberries, they were not particularly numerous. DNA marker techniques were also useful to document how a barberry invasion could progress from a cultivated purple-leaved cultivar used in a residential landscape.

JAPANESE BARBERRY SYMBIONTS

Little is known about the relationship between invasive plants and their symbiotic partners and any related success/control of plant invasions in natural environments (van der Putten et al., 2007). This is despite finding that symbionts may promote stress tolerance, enhance nutrient uptake, assist with general suppression of pathogens, and potentially serve as natural enemies (Roderiguez and Redman, 2008; Rosenblueth and Martinez-Romero, 2006). Symbiont research is focused on a fruit fly (*Rhagoletis meigenii*) and its potential as a biological control agent as well as soil biotic factors which may contribute to the invasiveness of Japanese barberry, especially in Acadia National Park, Maine.

Tephritid fruit fly larvae of *R. meigenii* consume at least one of the two seeds in Japanese barberry fruits during larval maturation. This relationship is being investigated regarding reductive effects of the fly population on the quantity and viability of seeds produced by infected plants. Fruit infestation rates and fly diversity are currently being studied along with the number of endosymbiotic *Wolbachia* bacterial strains found in the fly populations. *Wolbachia* infections are known to affect fly reproductive rates and population biology and thus, ultimately affect the number of Japanese barberry seeds consumed by the fly, annually. Wolbachia strains may be exploited for these properties.

A broad-scale gene sequencing approach is also being used to identify the fungal and bacterial species found in the root zone soil of Japanese barberry plants in Acadia National Park. Bacterial and fungal species common throughout the different soil types are of particular interest. These data will potentially allow for identification of species that may confer a competitive advantage to the invasive plant relative to native plant species.

CONSUMER EDUCATION AND INDUSTRY OUTREACH

Sharing information developed by the Center's faculty and staff is a primary component that is necessary for achieving the goals of the Center. The Center has sponsored and co-sponsored many conferences on invasive plants, many of which attract hundreds of attendees. We have also sponsored an International Symposium that brought together Asian and North American invasive plant researchers to formulate better ways to create solutions to invasive plants in the East and the West. Additional outreach efforts have involved high school students, Master Gardeners, and the gardening public.

LITERATURE CITED

Roderiguez, R., and **R. Redman.** 2008. More than 400 million years of evolution and some plants still can't make it on their own: Plant stress tolerance via fungal symbiosis. J. Exp. Bot. 59(5):1109–1114.

Rosenblueth, M., and **E. Martinez-Romero.** 2006. Bacterial endophytes and their interactions with hosts. Mol. Plant Microbe Inter. 19(8):827–837.

van der Putten, W.H., J.N. Klitonomos, and **D.A. Wardle.** 2007. Microbial ecology of biological invasions. ISME J. 1(1):28–37.