

Propagation at the U.S. National Arboretum, an Overview®

Barbara L. Bullock

U.S. National Arboretum, 3501 New York Avenue, NE, Washington D.C. 20002

Email: barbara.bullock@ars.usda.gov

INTRODUCTION

Established in 1927 by an Act of Congress, the U.S. National Arboretum is administered by the U.S. Department of Agriculture's Agricultural Research Service. The mission of the National Arboretum is to serve the public need for scientific research, education, and gardens that conserve and showcase plants to enhance the environment.

This presentation will discuss two divisions at the National Arboretum: the Tree and Shrub Breeding Program of the Research Unit and the Gardens Unit. These units focus on plant propagation for distribution, breeding, and display. Our breeding program encompasses a wide range: from basic and developmental research on trees, shrubs, turf, and floral plants to the development of plants with superior characteristics through a program of testing and genetic improvement. We develop new methods of pest and disease detection and control, improve our understanding of the taxonomy and nomenclature of ornamental plants and their wild relatives, and collect and preserve plant germplasm with ornamental potential.

The Gardens Unit works with a wide range of single-genus groupings in display gardens including azalea (my specialty), boxwood, daffodil, daylily, dogwood, holly, magnolia, maple, and peony. Major garden features include aquatic plants, the Asian collections, the Fern Valley native plant collections, the flowering-tree walk, the Friendship Garden, The Gotelli Dwarf and Slow-Growing conifer collection, the Introduction Garden, the National Bonsai & Penjing Museum, the National Capitol Columns, the National Grove of State Trees, and the National Herb Garden.

PROPAGATION FACILITIES

The mist system is housed in one of the glass-covered greenhouses, which have been in service since about 1961. While plans are in place to demolish our greenhouses and rebuild brand new modern facilities in the near future, these older glass houses still serve our propagation and growing needs for the time being.

Conventional mist benches with evenly placed emitters are utilized for propagation. The Mist-o-matic Electronic Leaf system regulates mist cycle by a balance system. The weight of water from the mist emitters lowers the electronic leaf, which in turn shuts off the mist. Then through evaporation, the leaf eventually rises again, triggering the mist to cycle on, wetting the leaf, and then shutting off the mist. This system works well for most of the horticulturists I interviewed for this article, since numerous activities prevent us from monitoring the mist system closely. In addition we also use timer-operated mist controllers that rely on photocells to help prevent the timed mist from over-watering new propagules.

David Kidwell-Slak, support scientist and propagator for the shrub breeding research program, has set up a fog chamber inside one of the glass houses in order to achieve 100% humidity, which is beneficial for some *Prunus* and *Cercis* cuttings.

The structure was built with a PVC pipe frame and covered with plastic and some shade cloth. A humidifier from a department store was attached. The jury is still on to how well this is working, but with cooler temperatures in the winter and spring, it should work well. The shrub-breeding program also operates a tissue culture lab.

GROWING MEDIA

Most of the horticulturists at the National Arboretum use three main ingredients to create rooting or seed-starting media with coarse sand, milled sphagnum, and perlite (1 : 1 : 1, by volume) most often used. Variations on this might be two parts coarse sand to one part milled sphagnum, which I currently use for azalea cuttings. For seed propagation, our horticulturist for the Asian collections uses milled sphagnum, coarse sand, and perlite (2 : 1 : 1, by volume); and the native plants horticulturist uses milled sphagnum and coarse sand (1 : 1, v/v) for general seed propagation.

RATIONALE FOR PROPAGATING

Each unit, garden, or display propagates for different reasons. The National Arboretum also serves as a back-up collection for other institutions. If a natural disaster occurs, we can ship replacement cuttings to help replace lost or stolen plants. This happened to the salvia collection at the Baton Rouge Botanical Garden after Hurricane Katrina. Our plant records department maintains an extensive database of information for all plants brought to the National Arboretum. The database (BG BASE) was developed specifically for use in botanic gardens, and most of us can input data directly into the database from our computers. All shipments of plant material are tracked in our database.

For the herb garden, more variety can be obtained through the raising of seed from specialty nurseries, and it's more economical. The horticulturist, Christine Moore, tells me that 80% of their propagation is done from seed (chili peppers and basil are the largest collections). Most seed is sown from late February through the end of May. The salvia (over 60 taxa) and pelargonium (about 75 taxa) collections are maintained only through propagation by cuttings.

For the native plants collection, curator Joan Feely uses wild-collected material from a known provenance whenever possible. This is important for research purposes if the plant is ever used for breeding. Joan raises most of her plants from seed but, last year, raised cuttings of our locally native *Viburnum dentatum* and *Lonicera sempervirens* for restoration purposes using rediscovered indigenous species.

For the azalea collection, I obtain cuttings from plants that are as near to the original source of that cultivar as is possible. For example, I collected cuttings of the North Tisbury azaleas from Ms. Polly Hill on Martha's Vineyard in Massachusetts. Polly Hill is responsible for introducing the North Tisbury azaleas to the nursery trade. Most of what I grow is from cuttings, but lately about 5% of what I grow has come from seed of native azalea species collected from the wild.

Susan Martin, horticulturist for the conifer collection, mainly propagates through cuttings from plants that revert or "misbehave," such as many of the selections of *Chamaecyparis*. She may repropagate selections from collectors such as William Gotelli who donated a sizeable collection of dwarf and slow-growing conifers to the National Arboretum in 1962. Cuttings are taken after three hard frosts, usually

between Thanksgiving and Christmas. Cuttings typically root in 3 months. Some pines and other species are grown from seed but it is only about 5% of her total.

Carole Bordelon, the horticulturist for the Asian collections, and Martin Scanlon, horticulturist at our Glenn Dale facility in Maryland, have traveled to China with NACPEC (North American China Plant Exploration Consortium) and brought back seed from many genera. The goals of these collection trips are to collect germplasm that increases the genetic diversity of the targeted genera, provide material for researchers to utilize in breeding for heat or cold hardiness, disease resistance, and drought tolerance, as well as conservation of germplasm. Many areas in China are not protected, and so material is collected for reasons of conservation. For many years, all *Acer griseum* in North America came from one location in China. Before a collecting trip, the participants create a target list of genera to collect based on many factors including research program needs and collection gaps. Documentation of propagation techniques for some of the seed they collect is limited; therefore, there is a need to try several different techniques to get optimal germination.

In accord with its mission "to develop new and improved cultivars of woody ornamental plants," the tree and shrub breeding program breeds plants for tolerance to pollution, disease, and pests. *Lagerstroemia* 'Natchez' is a successful National Arboretum introduction. With its warm, cinnamon brown bark, lovely white flowers throughout the summer, field tolerance to powdery mildew, and stately tree-like stature, 'Natchez' epitomizes elegance in the plant world. Margaret Pooler, head of the shrub-breeding program, said propagation is done for two major reasons: for distribution and to grow out seedlings from hybridizations. About 50% of what they propagate comes from seed and 50% comes from cuttings.

PRE-TREATMENTS AND SOWING PRACTICES

Fresh seed is stored in a cooler at 4 °C (40 °F) until planted. Some seed must be cold stratified for 2 to 3 months before germination, and some seed might even have double dormancy, which means it needs two cold seasons to germinate. Dr. Pooler uses a hot water treatment, rather than acid, to scarify *Cercis*. Many of the herb garden's larger seed need to be removed from husks (such as peanuts) or have the fuzz removed (cotton). Sweet peas are pre-soaked before being sown.

Pitcher plants (*Sarracenia leucophylla*, *S. alata*, and *S. purpurea*) can be temperamental in greenhouse conditions, but curator Joan Feely has found a way to raise them from seed using rain water collected in buckets outside or collecting water from air conditioners and dehumidifiers in order to avoid any chemicals that are found in our city water. In the future, Joan plans to construct a germination unit outside where seed can be exposed to natural temperature fluctuations and germinate naturally when the time is right in a rodent-free outdoor space.

SPECIAL PROJECTS

The herb garden has 10 specialty gardens: old-fashioned and David Austin rose gardens; the holly border; basil bed (25–30 varieties); chili pepper bed (60–80 varieties); salvia bed (60 or more varieties, most from cuttings); ornamentals; and containers. Acting curator Christine Moore depends on volunteers to sow and transplant the many hundreds of varieties of herbs raised from seed or cuttings.

Currently, the National Arboretum's woody ornamental breeding programs are focused on developing improved cultivars of *Lagerstroemia*, *Cercis*, *Prunus*, *Hydrangea*, *Clethra*, *Tsuga*, and \times *Chitalpa*, as well as other genera. In addition, the tree-breeding program is breeding trees for shorter stature for use under power lines. The program also includes breeding for sterility for ornamentals that tend to be invasive in some situations such as *Berberis* sp., *Ulmus parvifolia*, and *Ligustrum sinense* (Chinese privet). Cuttings are also taken for distribution of our USNA introductions in order to keep those introductions available to the consumer. We also propagate to save valuable germplasm that may be difficult or impossible to re-collect. Tissue culture is also used in the shrub-breeding program.

Tissue culture facilitates biotech applications, such as genetic engineering, and could be useful in the breeding program to introduce genes that might assist with disease and pest resistance, sterility, or ornamental traits. For example, studying the regulation of anthocyanin genes may make it possible to create plants with novel flower or leaf color by controlling the expression of this gene in various plant parts such as a red-leaved *Prunus laurocerasus* (common cherry laurel) or a purple-flowered crape myrtle.

Some difficulties are encountered in growing plants from cuttings or seed for display at the National Arboretum. We have problems with damping-off diseases on seedlings. Sometimes cuttings must be taken multiple times in order to obtain the desired number of plants for the collection because they don't always root for various reasons, including improper handling technique. With the limited staff available to work on projects, our dependence on volunteer help is becoming more and more important for our success. Volunteers are not always propagation experts, so training is very important. Periodically the mist nozzles can clog with calcium deposits and create inadequate coverage of a flat of seeds or cuttings. Genera like sundew and shortia present difficulties in germinating and may not make it into the display some years. Some junipers are extremely difficult to root and take several tries. *Prunus* 'First Lady', a National Arboretum introduction, must be rooted from juvenile shoots or suckers prompted from an older tree.

CONCLUSION

The Gardens Unit and the Tree and Shrub Breeding Programs of the Research Unit at the U.S. National Arboretum work together to make the arboretum the top quality research and educational facility that it is. Our researchers use the germplasm collected by horticulturalists from the U.S. and abroad for the work they are doing in breeding new and improved cultivars. Plants brought back from collecting trips, once determined to be of garden merit, are displayed in our gardens, with the new and unusual where they can be observed by the public and preserved for future generations. Our gardens feature plants that our research team has successfully bred and introduced to the nursery trade as well as other plants our researchers might utilize in future breeding work. All of this is accomplished by using the methods and principles of propagation, trying various techniques, using proper handling, and maintaining a clean growing environment.

Throughout the 446 acres of the National Arboretum, one can learn the values of design, variety, and nature. The herb garden features plants of industrial or

culinary use, the conifer collection features beautiful displays of evergreen plants that need full sun to prosper, while the azalea collection features a wide variety of azaleas for use in partial shade. The Asian collection features many plants that have become popular in our gardens, and the Introduction Garden features reliably good new plants and innovative ways to use the tried and true. Finally a visit to the native plants in Fern Valley introduces the public to concepts of conservation, invasive species, and the beauty of the natural environment. Propagation of plants helps us keep the gardens of the U.S. National Arboretum alive and healthy.