

Breeding and Evaluation of Perennials at Chicago Botanic Garden[®]

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INTRODUCTION

Both the nursery industry and the gardening public have an unquenchable thirst for new ornamental plants and information on plant performance in the landscape. In recognition of these interests, Chicago Botanic Garden has directed much of its research towards the development, evaluation, and introduction of ornamental plants for landscape and garden use in the Midwestern U.S.A. and beyond. The Garden's programs in plant breeding and evaluation will be discussed in this paper.

PLANT BREEDING PROGRAM

The program has two components. The older is the dieback shrubs project which was initiated in 1987 to evaluate the hardiness and display potential of shrubs considered marginally hardy in the Chicago area (U.S.D.A. Zone 5). Some of the genera evaluated (with varying degrees of success) included *Adina*, *Caryopteris*, *Clerodendrum*, *Cytisus*, *Epilobium*, *Lagerstroemia*, and *Lespedeza*. This program entered Phase II in 1991 with the initiation of breeding and selection of the most promising taxa. The genera in this category include *Buddleja*, *Callicarpa*, and *Vitex*. Most promising to date are two hybrid plants of *Vitex agnus-castus* by *V. rotundifolia*. Propagules are now under evaluation both at the Garden and with a number of cooperative evaluators around the country. Several more recently developed *Vitex* hybrids and a series of *Callicarpa* hybrids are also being propagated for evaluation.

The Garden then initiated in 1995 a program for the development of herbaceous perennial plants. The goal of this program is to develop through breeding and selection new perennials well adapted to Midwestern soils and climate. The genera currently in the breeding program are all native to North America, and so were selected not only to take advantage of the interest in gardening with native plants, but also to be able to incorporate both commercially available cultivars and wild-collected germplasm into the program. For some of the genera, the ability to incorporate genes from taxa wild-collected within a day's drive of the Garden may enhance the progeny's ability to adapt to the climatic conditions encountered in the Midwestern U.S.A.

The main genera currently in the program are *Baptisia*, *Echinacea*, *Liatris*, and *Penstemon*. New taxa will likely be added to the program over time. These genera were selected based on results and recommendations from the plant evaluation program at the Garden; for being already recognized as good garden subjects; for having minimal previous breeding work, or that work not necessarily for the gardening conditions of the Midwest; and for the potential for interspecific hybridization within each genus.

Why the emphasis on interspecific hybrids? It may be that by combining traits of species from diverse habitats that not only will novel ornamental traits result, but more importantly in advanced generations plants may be produced with even

broader garden adaptability, hardiness, drought tolerance, etc., than exhibited by the original parent plants. Based on the taxonomic literature, each of the target genera are known to form interspecific hybrids in nature, a good indicator for success with these plants. To date, interspecific hybrid plants have been produced for each of the target genera.

PLANT EVALUATION PROGRAM

Plant evaluation at the Chicago Botanic Garden began in 1982 with the opening of Pullman Evaluation Garden. This garden provides for the evaluation of a range of plants, including herbaceous perennials, vines, shrubs, and small trees in a landscape setting. The program was enhanced in 1990 with the opening of the Lavin Plant Evaluation Garden, a 2.5-acre site dedicated to the evaluation of herbaceous perennials. This garden provides a more uniform environment for plant evaluation, including full sun and exposure to wind in all directions. The purpose of this garden has now expanded and includes the evaluation of plants from the exploration, breeding, and introduction programs. The evaluation collection currently contains approximately 1400 taxa, representing almost 10,000 plants.

The goal of the Plant Evaluation Program is to evaluate plants and report our findings for the education of the nursery industry and gardening public. The program has evolved over the past 18 years from an informal to a formal program of plant evaluation. The evaluation process was formalized through the development of evaluation criteria and a data collection scheme; the implementation of the collection scheme; and the reporting of the evaluation results. Four general programs presented below make up the Plant Evaluation Program.

Target Genera Program. This program was initiated in 1989 to compare commercially available species and cultivars within a specific genus. The benefits of this program include: the comparison of old cultivars to new cultivars; the evaluation of new color forms of popular perennials, such as *Heuchera*; the examination of the breadth of a genus, e.g., growing all the species of *Echinacea*; the identification of superior forms of common garden plants; the cultivation of uncommon plants in our area, e.g., *Tricyrtis*; and the review of nomenclature and identification issues within a genus. There are currently 31 target genera in the program (Table 1).

Evaluation of New Horticultural Plants. Growing and evaluating plants unknown locally or new to the U.S.A. is an exciting aspect of the Program. Some of the plants come to us through a unique program called Collections 2000, which has collected plants from nurseries in Japan, England, Germany, Holland, and Poland. Many of these plants are new to cultivation in the U.S.A. Examples of plants we evaluated before they were commonly available include *Solidago rugosa* 'Fireworks', *Achillea sibirica* var. *camschatica*, *Monarda* 'Petite Delight', and *Clematis* 'Evisix', Petit Faucon™ clematis.

Plant Exploration Program. The Chicago Botanic Garden participates in plant exploration with a number of other institutions in the Midwestern and Eastern U.S. It has participated in trips to South Korea, the steppes of southern Siberia, Russia Far East, China, and the Republic of Georgia. Seed is collected in the wild, then grown and evaluated here for comparison to cultivated plants and for genetic variability. Superior plants will be introduced to the public through the Chicagoland Grows® Plant Introduction Program.

Table 1. Target genera from the plant evaluation program at Chicago Botanic Garden.

<i>Anemone</i> (fall blooming species)	<i>Lamium</i>
<i>Baptisia</i>	<i>Leucanthemum</i>
<i>Buxus</i>	<i>Monarda</i>
<i>Campanula</i>	<i>Nepeta</i>
<i>Cimicifuga</i>	<i>Oenothera</i>
<i>Clematis</i>	<i>Origanum</i>
<i>Clethra</i>	<i>Phlomis</i>
<i>Cotinus</i>	<i>Phlox</i>
<i>Digitalis</i>	<i>Sedum</i>
<i>Euphorbia</i>	<i>Stachys</i>
<i>Fothergilla</i>	<i>Thalictrum</i>
<i>Geranium</i>	<i>Tiarella</i>
<i>Helenium</i>	<i>Tricyrtis</i>
<i>Hydrangea</i>	<i>Trollius</i>
<i>Ilex</i> (deciduous species only)	<i>Veronica</i>
<i>Itea</i>	

Table 2. Evaluation and characterization criteria for the plant evaluation program at Chicago Botanic garden.

Autumn color period	Habit characteristics
Autumn color effect	Inflorescence size
Cultural factors	Maintenance given during season
Damage or injury type	Overall ornamental display
Environmental injury	Pest and disease problems
Flower size	Phenology
Flowering characteristics	Plant habit quality
Flower color	Plant health
Foliage color	Plant height
Fruit display period	Plant width
Fruit display quality	Vegetative winter injury
Fruit color	Winter color change
Growth form	Winter effect of bark and twigs

Cooperative Evaluation Programs. The Garden is associated with a number of other institutions, plant societies, and government programs for the cooperative testing of plants. We are currently testing plants for the USDA's NC-7 program (North Central Plant Introduction Station), the University of British Columbia plant introduction program (PISBG), the American Boxwood Society, the Holly Society of America, the American Ivy Society, and Conard-Pyle Nursery. Data and reports are regularly returned to the cooperative agencies.

The four basic criteria for the Plant Evaluation Program include: (1) Cultural adaptability to the soils and climate of the Chicago area, e.g., clematis for northern gardens, rhododendrons for alkaline soils, and endangered plants (such as, *Silene regia* and *Echinacea tennesseensis*); (2) Winter hardiness in U.S.D.A. Zone 5b, e.g., *Salvia koyamae*, *Kniphofia triangularis* (syn. *K. galpinii*), and English shrub roses; (3) Disease and pest resistance, e.g., black-spot-resistant hardy shrub roses and new roses including 'Knockout'™ PPAF™ and the Romantica Series, powdery mildew studies (phlox and beebalm); and (4) Ornamental attributes, including flower size, color and length of bloom; foliage color, and quality; habit quality; fruit characteristics and fall color.

Our computer-based evaluation scheme uses code numbers corresponding to various evaluation and characterization criteria with related descriptors (Table 2). The minimum evaluation terms are 4 years for herbaceous perennials, 6 years for vines and shrubs, and 10 years for trees. A full-time program manager and seasonal research assistant collect the data on a regular basis throughout the year.

Upon completion of the evaluation a written report is made in *Plant Evaluation Notes*, a periodic publication of the Chicago Botanic Garden. It is currently distributed to about 5000 botanical institutions, universities, extension agencies, landscape companies, nurseries, and gardeners. The report is routinely cited in industry journals and popular publications like *American Nurseryman* and *Horticulture* magazine. Additional promotion occurs through on- and off-site lectures, tours, and educational classes.

Together with other programs at the Garden, the plant breeding and evaluation programs are part of a continuum of information and plants being developed and disseminated to the gardening and professional public. Plants produced by the breeding program will be assessed for their display potential by the evaluation program; plants from either the plant breeding program or exploration trips that appear garden-worthy will then be commercially evaluated and disseminated through the plant introduction program, Chicagoland Grows[®], which is a corporate partnership between the Garden, The Morton Arboretum (Lisle, Ill.), and the nurseries of OGA (Ornamental Growers Association of Northern Illinois). The nine releases to date through Chicagoland Grows[®] have all been trees and shrubs. Herbaceous plant introductions will diversify the palette of plants while attracting new cooperative nurseries to the program, as many of the current licensed nurseries are solely or largely woody plant producers. Complementing our breeding work, The Morton Arboretum has a vigorous tree and shrub breeding program. Plants from that program also feed into Chicagoland Grows[®]. Through the Garden's resources, and those of its partners, a wealth of new ornamental plants and performance data should be introduced into the trade well into the future.