Date: November 13, 2006

Project Number: 07-06

Project Title: Development of new, superior cultivars of landscape plants

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Participating researchers at many institutions worldwide

Background and Literature Review:

The Landscape Plant Development Center is a non-profit corporation established in 1990 that develops stress tolerant landscape plants for all geographic climates. Research activities of the Center are accomplished as a cooperative effort of participating scientists at many institutions.

Literature Review:

The Centers cooperative breeding approach is based on evidence that tolerances to environmental stresses are quantitatively inherited. Hummel, et al., (1982) studied the inheritance of the photoperiodically induced cold acclimation response of Red-Osier Dogwood. Plants native at 62° N latitude were crossed with plants native at 42° N latitude and parents and progeny were grown at 45° N latitude. Laboratory determinations of cold tolerances during the fall acclimation period indicated that the F1 plants were intermediate to that of the two parents in hardiness achieved. Acclimation responses in the F2 generation were highly variable but most ranged between that of the two original parents. However a few individual plants exhibited transgressive segregation, they were either hardier than the northern original parent was or less hardy than the southern parent. Clausen and Heisey (1960) measured the survival of hybrids produced from altitudinal races of *Potentilla glandulosa* when grown at different altitudes. They observed transgressive segregation for many morphological characteristics as well as ability to survive.

Varieties of *Pyrus calleryana* have been used extensively in areas where they are cold hardy. However there are many other species that possess desirable qualities of tolerances to different environmental stresses and different forms, leaf color, etc. that are little known. Rehder (1962) lists 20 species native from Europe to East Asia, and south to N. Africa, Persia and Himalayas. The Center's breeding

efforts to develop a broader variety of small trees of ornamental pear has been described by Pellett and Hunt (1992) and Hummel & Privett (1992). Likewise, there are many species of *Acer* that have not been exploited for landscape use (Otis & Bassuk, 1998). Through breeding exciting new forms of both of these species can be developed. Wiegrefe (1995, 1996) describes successes of interspecies hybridization efforts with *Acer*.

Literature Cited:

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Wiegrefe, Susan. 1995. Maple crossability study: Year 3, Establishing credibility of crossability. Landscape Plant News 6(no 2.

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Justification of Project:

There is tremendous potential for development of landscape plants that are more tolerant of the biological and environmental stresses that often characterize the sites in which we plant and expect them to perform. Because of its cooperative approach, the Landscape Plant Development Center has the potential to develop many excellent new, well-adapted plants for all geographic areas. Plant materials are the lifeblood of the nursery industry and new plants provide great customer appeal.

Project Objectives:

This is an ongoing, long-term research project. Funds requested will be devoted to continuing and expanding our ongoing research to develop superior landscape plants with emphasis on plants more tolerant of environmental and biological stresses.

Research Approach:

Plant collections of participating institutions are utilized as parents to make desired crosses that combine stress tolerance with desirable aesthetic qualities. The first generation hybrids are usually intermediate in their tolerance to stresses between that of their parents. In the second generation, tolerance of a few individuals can equal or even exceed the tolerance of that of the most tolerant original parent. To take advantage of this potential, we grow the first generation hybrid population in a favorable climate (provided by our Oregon research station) and cross-pollinate those plants to produce the second-generation progeny. Plants of the second generation are then planted at different sites in many different geographic areas and superior plants well adapted to the climatic conditions of the region in which they are grown are then selected and further evaluated for potential introduction.

Current Status:

Currently we have major breeding efforts with interspecific hybridization of *Pyrus, Acer, Carpinus, Clematis, Physocarpus, Quercus, Buddleia,* and *Weigela.* We also are breeding *Viburnum, Syringa,*

Staphylea, Stewartia, Berberis, Magnolia, Hypericum Diervilla, Styrax, Lindera, *Baptisia, Sambucus,* and *Cornus*. Our research also includes developing sterile cultivars of valuable landscape species that become "weedy' and naturalize too freely into native ecosystems. The progress report recently submitted provides more detail on current research activities.

Overview of Methods and Time Lines:

Plant collections of participating institutions are utilized as parents to make crosses that combine stress tolerance with desirable aesthetic qualities. The first-generation hybrids are usually intermediate in their tolerance to stresses between that of their parents. In the second generation, tolerance of a few individuals can equal or even exceed that of the most tolerant original parent.

To take advantage of this potential, we grow the first-generation hybrid population in a favorable climate (provided by our Oregon research station and the Washington State University Research and Extension Center - Puyallup) and cross-pollinate those plants to produce the second-generation progeny. Plants of the second generation are then planted at sites in different geographic areas. Superior plants well adapted to the climatic conditions of the region in which they are grown are then selected and further evaluated for potential introduction. The activities at our Oregon research station complement those of the Oregon State Willamette Research Station and we work closely with their staff.

In addition to continuing and expanding the projects currently underway, we initiate additional breeding efforts as funding becomes available. In 2002, we initiated a cooperative breeding program with Cornell University and expanded that effort in 2003 by contracting for the services of Peter Podaras, plant breeder, to make interspecific crosses in many different genera using the plants in the collections of the Cornell Plantations. We are also cooperating with Dr. Tom Ranney, North Carolina State University, to develop sterile cultivars by ploidy manipulation and with Dr. Steven Strauss, Oregon State University, College of Forestry to develop sterile cultivars by genetic engineering. In 2005, we expanded cooperative efforts with Dr. Weinhoa Dai, North Dakota State University, to develop dwarf shrub cultivars by genetic transformation and mutation breeding. This effort also includes tissue culture activities to support our other research projects. For example, we will induce tetraploids of selected cultivars for use in our effort to develop sterile cultivars of invasive species. The Center is providing funding for a technician to conduct this cooperative effort.

We solicit input and feedback from the nursery industry on plant improvement needs and opportunities to develop pest resistance, environmental stress tolerance or plant aesthetic qualities in different desired genera. We have an advisory committee for our Oregon research station and look forward to expanding the size and role of that group as our research activities in Oregon continue and expand. We welcome anyone who would like to volunteer to serve on that committee. Current committee members are: Keith Warren, Dick Bocci, Todd Erickson, Pat Speer, Cathy Caldwell, and Mark Krautmann.

In 2005, we licensed nurseries to produce 'Center Glow' Ninebark, 'Center Star' Clematis and Silver Ball™ Pear, our first 3 introductions.

Research planned in 2007:

Interspecific hybridization of *Pyrus* —-We will continue our breeding efforts to develop superior small statured ornamental pears. Crosses will be made in 2007 between selected F1 hybrids to combine specific traits. Results from evaluation of existing populations for fireblight resistance, plant form, foliage quality, etc. provides data that helps us select best crosses to make. We have identified some individual plants that have not set fruit and are perhaps sterile. Additional selections will be made of plants that flower in 2007 but do not set fruit. These will be propagated for further evaluation. We will continue to evaluate all existing

hybrid populations at sites of our cooperators to select superior individual plants. We continue to select,propagate and plant promising plants at various locations for further evaluation under different climatic conditions. Based on data from various trial sites, we will begin to build up numbers of a few selections that appear most promising.

Interspecific hybridization of *Acer* – This research is continuing as a cooperative effort with the Morton Arboretum. First generation hybrids growing at our Oregon station will be used for additional hybridization of selected individuals. Seedlings were grown in a seedbed at Bailey Nurseries in Minnesota in 2006 from open pollinated seed of selected hybrids. These will be allowed to over winter in the field this winter to select cold hardy individual plants. Seeds to produce additional populations of F2 hybrids were planted this fall.

Interspecific hybridization of *Carpinus* – This effort is also being continued as a cooperative project between the Center and the Morton Arboretum. A number of our hybrids flowered in 2006 and we collected open pollinated seed to produce F2 hybrids for evaluation and selection of superior individual plants. A weeping selection was propagated in spring of 2006 by grafting and several other selections that have nice form and foliage characteristics have been identified and will be propagated by grafting this winter for further evaluation.

Hybridization of *Sorbus* with closely related genera – We are continuing with our efforts to develop superior Mountain Ash that are more tolerant of environmental stresses and have greater resistance to fireblight. Several selections were planted at our new research station in Minnesota in 2006. We will propagate 3 selections in 2007 for evaluation in different geographic regions. Two very compact plant selections and one with more typical growth habit look quite promising.

Development of Sterile Cultivars – We will continue our effort to develop sterile cultivars by ploidy manipulation and utilization of wide crosses. Seedlings grown from open pollination of our confirmed tetraploid *Acer ginnala* will be evaluated for ploidy level by use of flow cytometry in early spring of 2007. Tests conducted later in the growing season in 2006 gave poor results that made determination of ploidy level inconclusive. We have two plants of *Acer platanoides* that are confirmed tetraploids. These will be field planted to grow to flowering age. The ploidy analysis is being done by Dr. Tom Ranney's lab at North Carolina State University as part of our cooperative effort. We are establishing selected cultivars of several species in tissue culture for treatment with oryzalin to produce tetraploids. We have been observing our populations of *Buddleia* for sterility and low fertility. Quite a number of promising selections have very low fertility and a few seem to be sterile.

Development of non-vining cultivars of *Clematis* – Our continuing effort to develop non-vining cultivars of *Clematis* will primarily emphasize evaluation of hybrid populations from previous years crossing efforts. Information on flower quality, plant form and adaptability of hybrids resulting from previous crosses is needed before we can make the best judgment on parents to use in additional hybridization efforts. Some additional selections with large flowers will be propagated for further evaluation.

Cooperative breeding efforts with Cornell University – A large number of crosses have been made in many different plant genera and we are continuing to make additional crosses and evaluate progeny from previous crosses. Promising individual plants are being propagated for further evaluation. Seed resulting from 2006 crosses will be grown. Success of previous crosses will help us determine crossing efforts to

emphasize in 2007. We have propagated many selections of promising plants of *Buddleia*, *Weigela*, *Cornus*, etc. and are continuing to propagate additional selections for evaluation at other locations including at our new Minnesota station.

Development of rootstocks – Over the next couple of years, we will evaluate the dwarfing potential of the different pear selections that we have incorporated as interstem pieces with DeAnjou pear scions. Plants are now growing and plant height and amount of new growth will be measured at the end of each growing season for the next couple of years. Plants that appear to influence growth as interstem pieces will be propagated on their own roots for further research of their potential as dwarfing rootstocks.

Improvement of Native Plants– We are cooperating with Dr. Robert Schutzki, Michigan State University, in developing superior cultivars of native plant species. This effort was initiated by starting collection of germplasm of species native to the great lakes region of North America. A grant received from the USDA enabled us to collect native woody plants in Minnesota, Michigan and Iowa. Populations of these plants are now being grown in containers and in seedbeds. We will plant many of these at our new Minnesota station in 2007 to evaluate progeny and select individual plants with superior plant form, etc. We feel that many of our native plant species can be more useful in landscape situations with selection of plants with superior plant forms. We are concentrating on species that we feel have the greatest landscape potential and that are adapted to climatic conditions that pose difficulties such as areas with poor drainage, poor soil fertility, shaded areas, low soil moisture, etc.

Development of thornless varieties of barberry–In 2005, we collected a small amount of open pollinated seed from F1 plants and grew out the F2 population but unfortunately no plants were thornless with red foliage color. We were able to collect a larger quantity of seed in 2006 from the thornless green barberry growing next to red foliage cultivars. Seedlings of these will be grown in 2007.

Research Budget for the Year 2007:

We request that the Oregon Department of Agriculture Research and Regulatory Committee consider providing $35,000 to help support operation of our Oregon station and our breeding efforts for the next year in our ongoing research to develop new superior landscape plants.

Estimated budget to support the research activities of the Center from January 1, 2007 to December 31, 2007 is as follows:

Salaries & benefits of technical, and field maintenance staff	$190,000
Supplies	20,000
Utilities, insurance and other overhead at Oregon research station	9,000
Shipping	1,000
Equipment maintenance & purchase	8,000
Travel	9,000
Other	2,000
Total	**$ 239,000**

Other potential sources of funding for the project:

We request and receive funding from many different sources. Grants received during the past year include:

Horticultural Research Institute $33,000, Minnesota Nursery and Landscape Association $20,000, The St. Paul Garden Club $3,000, The Lake Minnetonka Garden Club $5,000, Stanley Smith Horticultural Trust $10,000, The Oregon Department of Agriculture Nursery Research Fund $25,000, The Bailey Nurseries Foundation $30,000, The Gordon and Margaret Bailey Foundation $10,000, California Association of Nurseries and Garden Centers $1,000 and Idaho State Department of Agriculture $5,000. In addition we receive contributions from many nurseries and individuals. Support for our research efforts is funded entirely from contributions and grants. As a non-profit organization, we do not have a base of support provided by tax dollars. As our research continues, our funding needs also expand to maintain the increased hybrid plant populations, etc.