

# CENTER FOR DEVELOPMENT OF HARDY LANDSCAPE PLANTS

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## INTRODUCTION

Due to widespread concern about global warming and its hazardous effects on the environment, many major promotional efforts are underway to encourage planting of trees and other landscape plants on a large scale to help alleviate the greenhouse effect. Unfortunately many trees and shrubs that are planted in landscapes die or perform poorly because they are not sufficiently tolerant of the stresses encountered.

For ‘Global ReLeaf’ efforts to be most effective, we need cultivars of trees and other landscape plants that are more tolerant to the stresses of urban environments such as soil ‘compaction, cold winters, hot summers, drought, air pollution, salt, and insect and disease infestations. Plants that are more tolerant of common stresses will not only survive and perform better, but will result in lower maintenance and replanting costs.

Unfortunately there is relatively little effort devoted to development of new superior, stress tolerant tree cultivars. A few years ago, Brooks and Vest (1985) conducted a survey of

public supported research efforts devoted to development of horticultural crops. In that survey they identified a total of approximately 7.6 scientist man years devoted to breeding and genetics of woody landscape plants. Their survey included USDA and agricultural experiment stations in land grant universities in the United States.

Fortunately, there is tremendous genetic potential for developing superior landscape plants. Developing stress-tolerant trees and shrubs will pay great dividends by helping to solve issues of chemical pesticide dependence, improving air quality, providing passive energy conservation, and helping to counteract the global warming trend.

The Center for Development of Hardy Landscape Plants has recently been established to aid and encourage efforts to develop landscape plants more tolerant of these stresses. To date researchers at over 30 institutions across the United States and Canada have made a commitment to the Center to cooperate in research activities directed toward developing stress tolerant landscape plants. An organizational meeting was held at the

Chicago Botanic Garden on March 6, 1990. Research efforts are now being planned and initiated.

#### GOAL OF THE CENTER

The goal of the Center for Development of Hardy Landscape Plants (CDHLP) is to encourage, expand and coordinate efforts to develop high quality landscape plants that are bred and selected for their tolerance to environmental and biological stresses. Research geared toward developing techniques for screening for resistance to various stresses and gaining information that aids in the breeding efforts will also be encouraged and supported. The major barrier to developing superior landscape plants has been a lack of research support and consequent lack of effort devoted to breeding landscape plants and to the related research activities. The Center will raise funds to support high priority research directed toward developing stress tolerant landscape plants adapted to many North American regions.

#### DESCRIPTION AND LOCATION OF THE CENTER

The Center For Development of Hardy Landscape Plants is a coordinated effort involving many institutions and individuals in many different locations. Headquarters for the Center is currently located at the University of Minnesota Landscape Arboretum. The Center was established to complement and increase

efficiency and scope of the modestly supported landscape plant improvement research programs. It is designed to support and encourage the breeding and development of plants selected for adaptation to specific regions representing a much broader area than that previously served by breeding programs. To effectively develop new plant materials, a broad base of plant germplasm is necessary. Thus plant exploration, plant preservation, and plant evaluation are important supporting activities necessary for the success of efforts to develop better plant materials for landscape use.

#### PARTICIPANTS

Participating institutions are involved in one or more of the Center's research activities. Many researchers are already involved in the cooperative activities briefly described or have indicated a commitment to become involved when funding becomes available and/or when the development of the research activities proceeds to the appropriate stage. Researchers involved or committed to participate are located at the following institutions:

Agriculture Canada Research Station  
Morden, Manitoba, Canada  
Arnold Arboretum  
Jamaica Plain, Massachusetts  
Chicago Botanic Garden  
Glencoe, Illinois  
Colorado State University  
Dept. of Horticulture  
Ft. Collins, Colorado

Cornell University  
 Dept. of Floriculture and  
 Ornamental Horticulture  
 Ithaca, New York  
 Denver Botanic Garden  
 Denver, Colorado  
 Holden Arboretum  
 Mentor, Ohio  
 Kansas State University  
 Horticultural Experiment Station  
 Wichita, Kansas  
 Longwood Gardens  
 Kennett Square, Pennsylvania  
 Michigan State University  
 Dept. of Horticulture  
 The Morton Arboretum  
 Lisle, Illinois  
 Mount Cuba Center  
 Greenville, Delaware  
 North Central Regional Plant  
 Introduction Station  
 Ames, Iowa  
 North Dakota State University  
 Dept. of Horticulture and Forestry  
 North Carolina State University  
 Dept. of Horticultural Science  
 Olds College  
 Olds, Alberta, Canada  
 Oregon State University  
 Dept. of Horticulture and  
 North Willamette Expt. Station  
 Pennsylvania State University  
 Dept. of Horticulture, and  
 Berks Campus;  
 Purdue University  
 Dept. of Horticulture  
 Royal Botanical Gardens  
 Hamilton, Ontario, Canada  
 University of Alberta  
 Devonian Botanic Garden  
 Edmonton, Alberta, Canada  
 University of Arizona  
 Extension Service

University of British Columbia  
 Botanical Garden  
 University of Georgia  
 Dept. of Horticulture and  
 Georgia Expt. Station, Griffin  
 University of Minnesota  
 Dept. of Horticultural Science,  
 Dept. of Plant Pathology and  
 Minnesota Landscape Arboretum  
 University of Nebraska  
 Dept. of Horticulture and  
 The Nebraska Statewide Arboretum  
 University of Pennsylvania  
 Morris Arboretum  
 University of Saskatchewan  
 Dept. of Horticultural Science  
 University of Wisconsin/Madison  
 Dept. of Horticulture  
 Washington State University  
 Puyallup Research and Extension  
 Center.

**ACTIVITIES NEEDED TO  
 ACCOMPLISH THE TASK**

To achieve the goal of developing a wide array of landscape plants adapted to the different climatic conditions of North America, two major types of coordinated research are necessary:

- 1) Applied breeding and selection, including support of exploration and germplasm preservation; and
- 2) Research into the genetic and physiological basis of stress tolerance in plants, so that screening techniques to rapidly select adapted plants can be developed.

Specific components of the breeding and evaluation research include:

1. Exploration and acquisition, both domestically and abroad, of potential parental plants; even within a species, source of germplasm is extremely important for adaptation. (Pauley and Perry, 1954)
2. Preservation or maintenance of germplasm for use in breeding efforts;
3. Characterization of potential parental materials to determine tolerance to various stresses thereby aiding in plant choice for use in hybridization; and
4. Hybridization of parental plants, growing of the F<sub>1</sub> population, and evaluation of subsequent generations in various regions for selection of the best adapted plants. Controlled screening techniques are also used at this stage for selection of plants tolerant to soil compaction, diseases, cold, drought, and other stresses.

To effectively conduct this research, a cooperative breeding and evaluation effort is needed. A cooperative program involving people at different locations can best take advantage of transgressive segregation for tolerance to environmental stresses and at the same time be much more cost efficient. First the initial crosses are made between plants possessing tolerance to stresses and others that have superior aesthetic qualities. Progeny from these crosses are then grown out and another generation, the F<sub>2</sub>, is produced by crossing selected individuals or by random pollination.

A site in a mild or moderate climate is needed for part of the hybridization effort in order to maintain potential parents that possess superior aesthetic qualities, but which may not have sufficient tolerance to survive in a harsher environment. Plants in the first or F<sub>1</sub> generation are usually intermediate in tolerance between the two parents and thus may not possess sufficient tolerance for the most severe climates. In the succeeding generations, however, there should be some individuals equal in tolerance to the hardiest original parent, and in some cases even more adaptable. (Hummel, et al. 1982). To efficiently test generations and to discover the best-adapted strains, F<sub>2</sub> populations will be planted at institutions located in different regions. Superior plants that are well adapted to each region will be selected from the same F<sub>2</sub> or later generation population. By sharing the results of the initial hybridization effort, this cooperative approach to producing superior plants selected for tolerance to different climatic regions represents an efficient use of scarce resources. Thus the breeding efforts coordinated by the Center can serve a much broader geographic area than can be well served by breeding programs conducted solely at one site.

Research into the genetic and physiological basis of stress tolerance necessary to gain a better understanding of how plants tolerate stresses and to develop screening techniques will be carried out by scientists from various institutions advising graduate students, post-doctoral fellows, or technicians.

Funding will support graduate student or post -doctoral fellow stipends, technician salaries, supplies, and some research equipment.

## **CURRENT STATUS**

Many of the components necessary for the research activities of the Center are already in place. The breeding programs of the Morton Arboretum, the University of Minnesota, the Agriculture Canada Morden Research Station, the Oregon State University, North Willamette Experiment Station, and the Royal Botanical Gardens provide a sound base upon which to build. The United States Department of Agriculture (USDA) National Plant Germplasm System has established a Woody Landscape Plant Crop Advisory Committee to determine germplasm research needs and advise administrators of the National Plant Germplasm System. This committee has recently completed the process of assessing needs, current resources and activities in the areas of plant exploration, germplasm preservation/evaluation and genetic enhancement. Based on their assessment, a report has been prepared that prioritizes future research needs in the areas listed. This report will serve as a guide to the administrators of the National Plant Germplasm System for their future efforts with woody landscape plant germplasm. It will also serve the Center well in planning research as the participants of the Center coordinate their efforts to achieve the greatest total results with the resources available.

The USDA has recently established a repository at the National Arboretum to preserve valuable woody landscape plant germplasm. In addition, the Plant Collections Committee of the American Association of Botanic Gardens and Arboreta is currently enlisting arboreta to undertake the preservation of a given species or genus of woody plants. Several members of this committee are also on the Woody Landscape Plants Crop Advisory Committee and are participants in the Center. This facilitates the coordination of efforts. The North Central and Northeast regions of the National Plant Germplasm System (NC 7 and NE 9) both have ornamental subcommittees that are involved in cooperative plant testing programs. Thus a network already exists that is being used to begin the evaluation phase of the breeding efforts.

Scientist support is facilitated by the recently established endowed chair for a visiting scientist in Environmental Horticulture at The University of Minnesota Landscape Arboretum. This chair will provide a changing source of expertise every 2-4 years to aid in conduct of the supporting research which fits the needs of the Center. In addition, many of the universities involved in the Center have a strong cadre of scientists with expertise in the areas of plant genetics, stress physiology, entomology, and plant pathology who are willing to advise and direct graduate students and become involved in the type of research activities described.

Additional scientists with other areas of expertise located at other universities and institutions have also indicated their willingness to aid in this effort when funding becomes available to support research. Research support is very limited at most universities at present. Thus, funding sources often dictate research activities. By supporting graduate students or post-doctoral fellows, modest funding can do a great deal to encourage senior research faculty to devote effort to desired projects.

To initiate the Center's broad-based evaluation and selection efforts, existing hybrid plant populations from existing breeding efforts will be used. F<sub>2</sub> populations of intergeneric hybrids of Sorbus and Aronia from the Minnesota breeding program will be field planted in various locations in the Great Plains area to select for plants possessing desirable aesthetic characteristics combined with greater drought and heat tolerance than presently available in mountain ash. Mature trees of interspecific hybrids between Acer tnmcatum and A. platanoides and between A. saccharum and A. grandidentatum are available in the collections at the Morton Arboretum. Progeny from these two populations have the potential to be selected for superior cultivars with greater tolerance to summer heat and drought than sugar maple and greater cold tolerance than Norway maple. Seedlings from these trees will also be planted at various sites to select for individuals possessing superior qualities. There are many other hybrid

populations available in plant collections of the participating institutions that have excellent potential for selection of superior cultivars under different climatic conditions. As resources become available more cooperative evaluation activities can be initiated and expanded and additional breeding efforts can be undertaken to develop other hybrid populations that have widespread potential.

## MANAGEMENT OF THE CENTER

The activities of the Center are managed by a Board of Directors, a coordinator of research, a research committee, and a promotional committee. The Board of Directors establishes policy, sets annual budgets, and creates guidelines for promotion of the Center. The coordinator of research is responsible for coordination of the research activities and provides liaison between the various parties involved. The research committee, consisting of representatives from the participating institutions, fosters development of cooperative research activities and determines and prioritizes research needs according to the mission, and makes priority funding recommendations to the Board. The promotional committee promotes the Center and helps in raising funds.

## LITERATURE CITED

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