Magnolia macrophylla. This is the largest-leafed American native tree and is hardy to -25 ºF. The leaves can be 2 to 3 ft long. The flowers are 15 inch across in early summer.

***Magnolia virginiana* 'Satellite'**. This evergreen magnolia has 3-inch dark-green leaves that have a silver tomentum underneath. The flowers are creamy white from late June-September. It can grow in very wet areas.

Magnolia grandiflora. The glossy green leaves are the perfect backdrop for the large white flowers in summer.

Magnolia hypoleuca. This species has 18-inch dark-green leaves all summer. In fall the foliage color turns to yellows, tans, and rust.

The winter silhouette and bark of magnolias can be used to great effect in the garden during winter.

It's time for spring to come again. The buds of magnolias can be very attractive during fall to spring. Magnolias can be used for the winter buds, spring to late summer blooms, deciduous or evergreen foliage, and structure for the garden and shade to grow other woodland plants.

Breeding Plants for a Better Tomorrow©

Sarah Doane and Harold Pellett

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The Landscape Plant Development Center is a relatively young organization. It was established in 1990 with a mission of developing superior landscape plants with emphasis on plants that are more tolerant of biological and environmental stresses. The Center was started because there is a need for greater diversity of landscape plants that are tolerant of environmental and biological stresses. Unfortunately, many landscape plants that are presently available are not well adapted to withstand the harsh conditions of the man-modified environments found on many landscape sites. The Center is a nonprofit corporation with a Board of Directors from all over the United States. The Center relies completely on grants and donations for the support of its research efforts. It operates as a cooperative effort of researchers located at many different institutions across North America, Europe, and Asia. Headquarters for the Center is at the Minnesota Landscape Arboretum.

We utilize the following general approach for our breeding projects: the cooperative nature of the Center, allows us to use the plant collections of participating institutions to do hybridization. This gives us access to a very broad range of diverse germplasm. First generation hybrids (F_1s) are grown at a location with a very favorable climate. When a plant with good tolerance to a given environmental stress is crossed to another plant that may not be very tolerant but that possesses other desirable qualities, the first generation hybrids are intermediate in tolerance to the stress between that of the two parents. Thus, if these hybrids were grown in a severe climate the F_1 population may not survive. However when the next generation of plants is produced by intercrossing the F_1 siblings, some of the progeny will be as stress tolerant as the most tolerant of the original parents and a few plants may

even have greater tolerance than the tolerant original parent. We can therefore select those individuals that combine the desired qualities from the less tolerant parent with the tolerance of the hardier parent. Second generation hybrids are planted in many different geographic regions by our cooperators. Superior plants will be selected from these populations that are well adapted to the climatic conditions of the region in which they are selected. Currently we have projects well underway to develop ornamental pears, maples of small stature, superior new hornbeam cultivars, nonvining forms of *Clematis*, sterile cultivars of plants that have invasive tendencies or that have unsightly seedheads or messy fruit, and superior forms of different shrub genera. To operate in a very efficient and effective manner, we develop many different cooperative projects with researchers at different institutions. This allows us to leverage use of facilities, people with different expertise, and mature plant collections that various arboreta have in existence. Cooperative efforts include work with Dr. Rita Hummel, Washington State University – Puyallup. Rita is growing our first generation hybrid pears at Puyallup and doing the seed propagation of our advanced pear hybrids and other crosses in their greenhouses. We are cooperating with Dr. Tom Ranney, North Carolina State University, in our effort to develop sterile cultivars by ploidy manipulation. To develop sterile cultivars by gene transfer, we are cooperating with Dr. Alan Smith, University of Minnesota, Dr. Steve Strauss, Oregon State University, and Dr. Herb Aldwinckle, Cornell University. They are providing the expertise and laboratory facilities for those studies and we are providing some funding to help support technical assistance. We are also involved in helping to initiate successful tissue cultures that are needed for successful transformation. We have initiated a cooperative breeding program with Cornell University. The Center has contracted with Peter Podaras to make crosses using the plant collections at the Cornell Plantations and the facilities of the Horticulture Department at Cornell. Peter has made a large number of interspecific crosses in many different genera during the 2003 growing season.

Our research station in Oregon is the only facility that the Center owns and operates. The University of Minnesota Landscape Arboretum provides office space to me as Professor Emeritus which we use as the Center's Headquarters. I use some plot land at my home for growing our *Clematis* hybrids and a few other hybrids, etc.

Sarah Doane is manager of our Oregon research station. She will now provide some insight on the activities at the station.

BREEDING ACTIVITIES

The first step in any breeding project is to determine what parents to use. In determining the parents we look at several factors including the plant's history, hardiness, tolerance to biological and environmental stresses, and industry needs. Also taken into account are the plant's physical characteristics including fall color, branching structure, growth habit, and the quality of flower and fruit set. We choose parents that have characteristics that complement one another.

POLLEN COLLECTION AND MAKING CROSSES

After the parents have been determined, one is chosen as the seed parent and the other as the pollen parent. To prevent open pollination from occurring, a waxed bag is placed over the flowering branch of the seed parent, before the flower buds open, and secured with a twist tie. For ease of pollen collection, I collect "bouquets" of flowering branches from the pollen parent and bring these indoors. These 'bouquets'

are labeled and placed into quart jars with a ratio of 10 parts H_2O : 1 part Floralife. This helps to force early flowering and allows me to collect pollen over a longer period of time. The pollen is plucked using tweezers and placed into an empty gelatin capsule. To help dry the pollen and keep it dry, the capsules are stored in a small jar containing anhydrous calcium sulfate. To maintain pollen viability the jar is stored in a refrigerator until needed.

Prior to making the crosses we determine whether or not to emasculate. This decision is made based on morphological characteristics of the flower and the historical results of prior crosses. If the flowers are unisexual or if the plant is completely self-incompatible, then it is not necessary to emasculate. If emasculation is necessary all anthers must be removed prior to the ovary becoming receptive. When the seed parents are ready, that is, the flower buds are fully opened and the ovary is receptive, it is time to make the controlled crosses. Using very small paintbrushes, I brush the pollen onto the stigma. After all the flowers have been pollinated, the bag is replaced and left until seed or fruit has developed. To prevent contamination between crosses all tools must be cleaned in a 70% alcohol solution.

SEED COLLECTION AND PROPAGATION

In the fall the seed of all successful controlled crosses is collected. At this time we sometimes also collect seed from open-pollinated crosses. Collected seed is sent to Washington State University – Puyallup Research and Extension Center, where it will be grown for approximately 1 year. These seedlings are screened for disease and insect susceptibility as well as general plant health. Any less than desirable plants are discarded at this time. The remaining plants are then sent to the Oregon Research Station for continued evaluation and use in further hybridization.

EVALUATING HYBRIDS

The Oregon Research Station provides desirable growing conditions for the first and second generation hybrids. These are field planted and evaluated for several years. Evaluation includes bud break, flower and fruit set, leaf color, fall color, and tolerance to disease and insect pressures. This is done yearly for each individual plant. Our *Pyrus* and *Sorbus* hybrids are inoculated with *Erwinia* to screen for fireblight resistance. This has proven a useful tool in keeping our hybrid populations manageable. Trees or shrubs that succumb to disease or lack desirable traits are rouged from the field.

PROPAGATING ADVANCED SELECTIONS

Through our evaluation process, we find individual plants that have great potential in the landscape. These selected individuals are propagated by either budding, tissue culture, or rooted cuttings. Budding has been made possible through the cooperation of Oregon nurseries such as J. Frank Schmidt & Son Co., Baileys Nurseries, Carlton Plants, and Speer and Sons Nursery. It is important for us to see how these plants perform in nursery growing conditions. These are then shipped to various cooperators around the United States where they will continue to be evaluated.

INTRODUCTION OF NEW LANDSCAPE PLANTS IN 2003

This year we have chosen two plants for introduction, a *Physocarpus opulifolius* hybrid and a nonvining *Clematis* hybrid. We have started to propagate these this year to build up our number of stock plants. These will be the first introductions from the Landscape Plant Development Center's breeding efforts.