

Wisconsin Forest Tree Improvement Program

2010 Annual Report



**WDNR Forest Genetics Program
and
UW Madison, Forest Ecology and Wildlife Management**



Tree Improvement Program

The Wisconsin Tree Improvement Program, through the long-term support of the state nurseries, continues to develop and manage seed orchards using a combination of parent tree and family selection, progeny testing, and selective breeding. First generation seed orchards currently are established for white pine, jack pine, red pine, white spruce, red oak, and black walnut. Second-generation seed orchards are established for jack pine.

Priorities for 2010 included growing out an 80-family controlled cross 3rd generation jack pine breeding population, pollarding the 14-year old Ten Mile II jack pine seed orchard, harvesting controlled crosses at the 10-year old Ten Mile III 2nd generation jack pine breeding population, rogueing the 21-year old Mead Wildlife Area white spruce progeny test for use as a seed orchard, and establishing a butternut progeny test-seed orchard in Crawford County. The program also continues to monitor seed orchards and progeny tests and collect data on variation in tolerance and resistance to various pathogens. White pine blister rust surveying was completed at the eight-year old white pine progeny test in the Black River State Forest.

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2010 Tree Improvement Program Highlights

Seed orchards are the primary mechanism used to produce genetically-improved seed in quantities large enough to support nursery production. We continue to expand and develop our seed orchards for white pine, jack pine, red pine, white spruce, and black walnut (Table 1). Our work also continues to emphasize critical maintenance and intensive management of seed orchards to facilitate the production of greater quantities of improved seed.

Table 1. WDNR Seed Orchard Acreage By Species

Species	Acreage	Counties with Major Orchards
Jack Pine	20	Rusk, Waushara, Wood
Red Pine	45	Iowa, Oneida, Wood
White Pine	52	Jackson, Oneida, Washburn
White Spruce	34	Marathon, Oneida, Washburn
Black Walnut	14	Crawford, Grant, Green
Butternut	1	Crawford

This report highlights the 2010 program activities and accomplishments for our principal tree improvement species. Please feel free to contact program staff if you have any questions or comments.

Strategic Plan

A new 10-year strategic plan was completed during 2009 which prioritizes the programs goals through the next decade. The intent of the program is to maintain a focus on seed supply for the DNR State Nursery Program, species conservation, and adaptability testing. You may request a copy of the plan by contacting Kristin Peterson.

Greenhouse

After many years of planning, the joint WDNR Forest Health Lab/Forest Genetics greenhouse facility at the South Central Region headquarters in Fitchburg was completed in 2009. A day-long open house was hosted in March, 2010, by Tree Improvement and Forest Health personnel. Approximately 75 people took part in the event. This facility improves the program's ability to propagate future research plantings and enhance our ability to produce grafted/clonal seed orchards.



Greenhouse Production of 3rd Generation Jack Pine Seedlings

Jack Pine

Jack pine is one of the most widely distributed conifers in Wisconsin and is the third highest selling tree species produced by the DNR State Nursery Program. The species is characterized by large amounts of genetic variation for characters such as growth rate, stem form, and wood specific gravity. Opportunities for genetic improvement in these traits are exceptional as jack pine is a precocious flowerer, produces regular cone crops, and is adapted to a wide range of sites.

Ten Mile II

In 1980, the University of Wisconsin-Madison, Dept. of Forest and Wildlife Ecology, established four jack pine 'index' populations at the University's Hancock Research Station (Waushara County). These four populations provide a research framework for genetic studies and coordination of a testing and breeding scheme. Each population contains twenty families originating from Wisconsin, Minnesota, and Michigan parents. Research with these populations confirmed high levels of variation noted in earlier provenance and progeny tests. Estimates of genetic gain for growth rate alone range from 11-15% following selection of the best individuals from the best families to serve as parents.

In 1996, a six-acre 2nd generation breeding population was created through controlled crosses amongst the best individuals within each family and was out-planted at the DNR Ten Mile Creek Seed Orchard Complex (Wood County). In the spring of 2008, controlled crosses amongst the best individuals from all 80 families in the 2nd generation population were performed. Parent trees were selected based on height growth, pine-oak gall rust (*Cronartium quercuum*) tolerance/resistance, and stem form. These crosses were harvested in the fall of 2009 and generated over 8,000 seed. In January 2010, these seed were sown at the new Forest Genetics greenhouse facility at the DNR South Central Region headquarters and grown for six months under optimal conditions, resulting in enhanced growth rates and no mortality. In June, the seedlings were out-planted at the DNR Wilson State Nursery in Boscobel to finish their growth cycle and become acclimated to outdoor conditions. In the spring of 2011, these seedlings will be lifted and planted to create a 3rd generation seed orchard located in the Black River State Forest. Future cones produced by these trees will be used by the State Nursery Program which has sown jack pine seed collected almost exclusively from Forest Genetics seed orchards since 1990.

The Ten Mile II 2nd generation jack pine population was thinned to seed orchard spacing in 2009, leaving only superior individuals from each of the 80 families while allowing space for increased cone production and minimizing competition. In order to better facilitate future cone collection within the orchard, Tree Improvement staff, along with Griffith State Nursery personnel, pollarded trees by removing the upper 1/3 from tree crowns within the orchard during the last two years. The removal of this portion of the tree forces flower production lower in the crown and makes the cones easier to access from the ground. In 2010, 510 trees were topped, adding to the 266 trees that were topped in 2009. The remaining 250 trees in the orchard will be topped in 2011. Staff collected 29 bushels of cones from the removed tops with the resulting seed being used by the state nursery system for future jack pine seedling production.

Ten Mile III

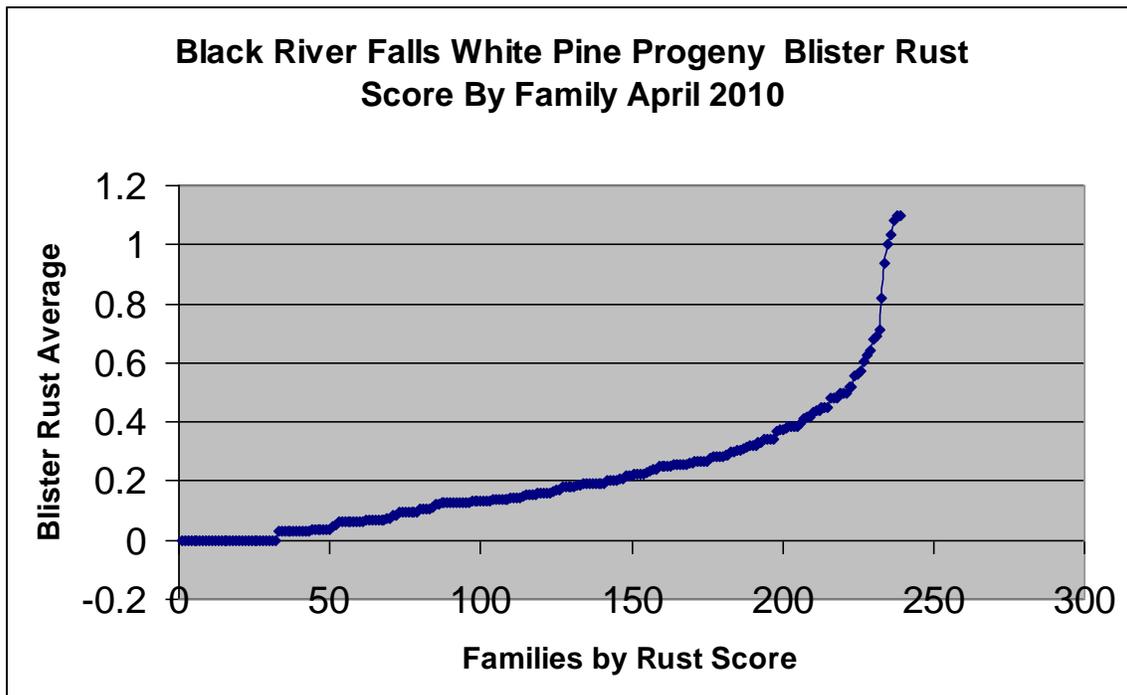
This planting was established in 1999 and contains 2nd generation trees from 20 families. The families originated from controlled crosses made in two different Wisconsin breeding populations composed of materials from the western Great Lakes states. During the spring of 2009, parent trees from each of the 20 families were selected for controlled crosses based on superior tree growth, pine-oak gall rust tolerance/resistance, and stem form. Following selection, 136 controlled crosses were completed with 20 select females, generating 243 cones that were harvested in the fall of 2010. Once extracted, these cones generated over 4900 seed that will be used to generate a genetically enhanced 3rd generation breeding population.

Eastern White Pine

Black River Falls

In 2003, an 8000-tree white pine planting was established on a 10-acre site located on the Black River State Forest by Black River Falls, WI (Jackson County). The planting is composed of trees from 240 unique families from Wisconsin, Minnesota, and the upper peninsula of Michigan. In the spring of 2010, this planting was surveyed for white pine blister rust. The survey was conducted by tree improvement staff with assistance from WDNR West Central Region forest pest specialist, Todd Lanigan.

The trees were scored using a 0 to 4 scale (0 - no rust, 1 - one stem canker, 2 - two to three branch cankers, 3 - at least one stem canker and/or more than 3 branch cankers, 4 - mortality putatively associated with blister rust due to stem cankers). Statistical differences in susceptibility exist among families. Most families showed low to moderate infection rates with fewer than 50 families showing high levels of infection, while 32 of the families showed no signs of rust. Interestingly, 13 of the worst 25 families are local selections from Jackson County.



Sawyer Creek

Beginning in 1983, through a cooperative effort with the USDA-Forest Service, grafts of putative blister rust-resistant eastern white pine were obtained and planted within a 10-acre clonal seed orchard at the Sawyer Creek Fishery Area (Washburn County). Seed volumes collected from this clonal orchard have steadily increased since 1990 and have recently been

used by the state nurseries. Between 1994 and 2003, a number of open-pollinated progeny from these clones were planted in two nearby fields and monitored for height growth and blister rust incidence. One clone was eliminated from the seed orchard based on poor seedling performance in this test.

During the winter, the older of the two open-pollinated blister rust progeny out-plantings was mechanically thinned using a Fecon bull hog brush cutter. The thinning removed two of every three rows and every 3rd tree within the rows. This thinning will now allow this six-acre planting to be used as a seed orchard. To further increase the efficiency of cone collection within the clonal seed orchard, Tree Improvement and Hayward nursery personnel removed limbs from the lower 12 feet of all the trees. This will allow a lift truck to gain better access to each tree and help prevent tree and equipment damage in the future.



Sawyer Creek White Pine Progeny
Thinning



Sawyer Creek Clonal Seed Orchard
De-limbing

Red Pine

Three 15-acre seedling seed orchards consisting of 310 families from native Wisconsin stands were established in 1970 at Avoca (Iowa County), Lake Tomahawk (Oneida County), and Ten Mile Creek (Wood County). These seed orchards were thinned between 2004 and 2006 using height data to retain the tallest families and best-formed trees for seed production.

The 'best' individuals from within the tallest 125 families at each orchard were identified during 2003-04 using diameter measurements (in lieu of height – the trees are over 60 feet tall) and stem form ratings. Beginning in 2004, open-pollinated cones have been harvested from these trees as they become available. In the fall of 2009, an additional 191 cones were collected from selected trees. There is now enough seed for all selections to be used to establish a second-generation seed orchard. Propagation of these trees will begin during the winter of 2012 in the Forest Genetics greenhouse facility at the DNR South Central Region headquarters.

White Spruce

White spruce tree improvement efforts continue to focus on the intensive management of seed orchards and evaluation of progeny tests in order to supply improved seed for WDNR nursery production.



Mead Wildlife Area White Spruce Seed Orchard Canopy, Summer 2009

Planted in 1982, the six-acre Mead Wildlife Area (Marathon County) progeny test contains 175 families representing materials from the Ottawa Valley of Ontario, Canada and selections from the Lake States region made by the USDA-Forest Service. The shortest 30% of this population was thinned out in 2007 based on 1997 height data while preserving the best individuals from all families. Seed for use by the state nurseries has been collected from the orchard using a lift truck since 2002, with 50 bushels of cones being harvested in 2009. Lift truck access within the orchard is still limited due to the density and size of the planting. In order to optimize future harvests within the orchard, additional thinning of the orchard was initiated in 2010 and 40% (511 trees) of the orchard was marked for removal while still preserving the best individuals from all families. Tree Improvement staff, with assistance from Griffith State Nursery personnel, removed 190 trees from the orchard during the summer and will resume thinning at the orchard in 2011.

Butternut

Butternut, a close relative to black walnut and often referred to as white walnut, has been slowly dying off in Wisconsin since the exotic butternut canker disease (*Ophiognomonia clavignenti-juglandacearum*) was first reported in the state in 1967. Trees infected with the fungus develop branch and stem cankers that eventually girdle and kill the tree. A native Wisconsin tree, butternut is found throughout the state, with the exception of the northern-most counties, and is prized for its nuts by both wildlife and humans and for its quality lumber.

Beginning in the 1980's, an increasing number of disease-free trees have been identified growing alongside infected trees throughout the species range. While tolerance or resistance to the disease has yet to be confirmed, putative disease-free trees from infected areas have been screened and indicate there is a wide phenotypic variation in susceptibility to the disease. Along with this, recent studies have shown that there is a high level of genetic diversity present within butternut across its range. Given its environmental and economic history in Wisconsin's landscape and continued disease pressure, it has become apparent that an active program is needed to conserve the species to help prevent its extinction from the state.

In the spring of 2010, the Tree Improvement program, working in conjunction with the USDA-Forest Service Hardwood Tree Improvement and Regeneration Center at Purdue University, established a one-acre progeny test. The planting, located on the Kickapoo River Wildlife Area, Bell Center Unit (Crawford County), is composed of 74 trees from 20 Wisconsin selections. These selections were derived from parent trees that are putatively disease-free and have been screened using genetic markers to insure that they are pure butternut and not hybrids. Over the next several years, Tree Improvement staff will monitor these trees for disease occurrence and disease-free trees will be used to procure seed for the State Nursery Program.

Black Walnut

Black Walnut remains a species of great importance to landowners and the forest products industry in southern Wisconsin. To date, our efforts have focused on identifying superior quality trees in natural stands and grafting scion wood from those trees into clonal seed orchards. During the last two years, fifty-six additional potted grafts generated from 15 superior quality trees originating in Wisconsin and northern Illinois were out-planted at the seven-acre Bell Center (Crawford County) clonal seed orchard. During the course of the summer, the orchard was maintained by mowing and herbicide application around each tree to further reduce competition. The poly deer fence erected around the orchard continues to show wear and required mending a number of times during the year.