Wisconsin's Reforestation Programs

2014 Annual Report

Wisconsin Department of Natural Resources
State Forest Reforestation Program and
Forest Genetics Program

and

University of Wisconsin-Madison
Department of Forest and Wildlife Ecology

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Introduction

The Wisconsin Department of Natural Resources' (WDNR) reforestation efforts consist of three linked programs: 1) the Tree Improvement Program, a WDNR collaboration with the UW-Madison, Department of Forest and Wildlife Ecology, which works to ensure WDNR tree seedlings are well adapted to Wisconsin growing conditions and have a high potential for survival and growth; 2) the State Reforestation Program (formerly the State Forest Nursery Program) which produces and ships native forest tree seedlings for reforestation projects from facilities in Boscobel, Wisconsin Rapids, and Hayward to customers throughout Wisconsin; and 3) the Reforestation Monitoring Program which monitors out-planted seedlings to assess seedling survival, growth, and long-term health.

2014 Tree Improvement Program Highlights

The Wisconsin Tree Improvement Program, with the long-term support of the state forest nurseries, continues to develop and manage tree 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 and third-generation seed orchards are established for jack pine.

Priority assignments completed during 2014 included (1) the establishment of a 2 acre, 20-family, 3rd generation jack pine seed orchard at the Hayward State Nursery; (2) completion of a 60% thinning of the 10-acre, 240-family Black River Falls white pine progeny test; and (3) pollarding of the 20-family, Ten Mile Creek III second-generation selection and breeding population. The program also continues to monitor seed orchards and progeny tests and collect data on variability in tolerance and resistance to various pathogens.

Seed orchards are the principle technology 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, black walnut, and butternut production (Table 1). Our work also emphasizes the critical maintenance and intensive management of seed orchards to facilitate the production of greater quantities of improved seed.

Species	Acreage	Counties with Major Seed Orchards
Jack Pine	27	Jackson, Rusk, Sawyer, 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	2	Crawford, Sawyer

Table 1. WDNR Genetics Plantings Acreage by Species

This report highlights the 2014 program activities and accomplishments for our principal tree improvement species. Please feel free to contact program staff if you have any questions or comments.

Jack Pine

Jack pine (*Pinus banksiana*) is one of the most widely-distributed conifers in Wisconsin and is the third most popular (by sales) tree species produced by the WDNR State Reforestation Program. The species is characterized by large stores of genetic variation for numerous characters, including growth rate, stem form, and wood specific gravity. Opportunities for genetic improvement in these traits are excellent as jack pine flowers at an early age, produces regular cone crops, and is adapted to a wide range of sites.

Ten Mile III breeding population

This planting was established in 1999 (Wood County) and contains second-generation trees from 20 families originating from controlled crosses made in two different Wisconsin breeding populations. These populations were composed of trees drawn from Minnesota, Wisconsin, and the Upper Peninsula of Michigan. The planting was thinned to seed orchard spacing in 2013, leaving only superior selections from each family. During the summer of 2014 Tree Improvement staff, along with Griffith State Nursery personnel, pollarded these remaining trees, removing the upper 1/3 of each tree's crown. The removal of this portion of the tree forces flower production lower in the crown and makes future cones easier to collect from the ground. Though the cone crop was minimal this fall, 4 bushels of cones were harvested from the cut tops which will be used by the State Reforestation Program to produce improved jack pine seedlings.

Figure 1. Planting 3rd generation jack pine breeding population at Hayward Nursery Summer 2014 (Photo by David Stevens, U.W.-Madison)

Hayward 3rd generation breeding population

Beginning in 2009 and continuing through 2012, controlled crosses were made between superior parent trees at the 20 family Ten Mile Creek III 2nd generation breeding population. Parent trees were selected from each family based on growth rate (height), tolerance/resistance to pine-oak gall rust (*Cronartium quercuum*), and stem form. The breeding method employed a poly-cross scheme in which five different pollen cells each composed of equal amounts of pollen collected from 4 different families were

mixed and used to pollinate flowers on a select parent tree. This method was used to ensure a high level of genetic variability in the progeny and to allow for continued selection in subsequent generations. During the winter of 2013, seed from the crosses were surface sterilized and sown at the Forest Genetics greenhouse at the WDNR South Central Region headquarters and grown for six months under optimal conditions, resulting in excellent root and stem growth rates. Given their size and vigor, the trees were subsequently planted directly into the field the same year. In mid-July, with assistance from Hayward State Nursery personnel, 960 trees were planted using a randomized complete block design with four-tree plots and 12 replications on a 2 acre site at the DNR Hayward State Nursery facility (Figure 1). Survival has been excellent due in part to the availability of irrigation and deer fencing at the site. Evaluation and selection will continue in this population as it matures in the future.

Eastern White Pine

Figure 2: Cut stump treated with Cellu-Treat and blue tracer dye to prevent annosum root rot
(Photo by Kyoko Scanlon, WDNR)

Black River Falls test planting

Planted in 2003 on a ten-acre site in the Black River Falls State Forest (Jackson County), the test consists of 8000 trees from 240 unique families from Wisconsin, Minnesota, and the upper peninsula of Michigan. Data collected from the planting has been used to better understand the extent and patterning of variation in Wisconsin's white pine populations and to provide a source of improved seed for the State Reforestation Program. Significant regional and stand differences have been observed in growth rate and blister rust susceptibility.

Now at 11 years of age, the planting is in need of thinning to prevent stunting of superior trees. Using ten-year height and blister rust data, 60% of the trees were selected and marked for thinning in 2013. Following marking, roughly 1000 of the marked trees were cut and removed from the planting by Tree Improvement staff during the late fall and early winter of 2013 until deep, persistent snow put a halt to work. A late spring thaw followed by a wet summer slowed thinning of the remaining 3800 trees, however, work on the thinning was eventually completed in early December, 2014. Cut stumps were treated with Cellu-Treat (disodium octaborate tetrahydrate) as a preventative measure against the spread of annosum root rot (*Heterobasidion*

irregular), a highly destructive conifer disease first found in Wisconsin in 1993 and currently identified within 25 miles of the site (Figure 2). Eventually, the planting will be managed to provide a source of improved white pine seed.

Red Pine

Historically, red pine has been the primary conifer used for reforestation purposes in the north central United States and is still the most popular (by sales) tree species produced by the WDNR State Reforestation Program. Though it has a reputation for poor natural regeneration, its ease of planting, excellent form and high productivity on pine sites has long made it a preferred reforestation species. From a genetic standpoint, red pine is an anomaly among pines in possessing comparatively little genetic variation. Results from provenance studies indicate that small, though significant, differences in growth rate can be detected among red pine seed sources, but the range of genetic variation observed is much less than that found in other pines.

Figure 3: 2nd generation red pine seedlings Wilson State Nursery Summer 2014
(Photo WDNR)

As such, tree improvement and breeding efforts with red pine are somewhat controversial because of the obvious restriction of potential genetic gain. However, in light of the extensive red pine reforestation program in Wisconsin, and resultant seed requirement, a red pine tree improvement program was developed in Wisconsin beginning in 1965. The basic justification for the program was that even small genetic gains, when applied through large reforestation programs, can have substantial cumulative benefits. As a result, three red pine (*Pinus resinosa*) 15-acre seedling seed orchards utilizing open-pollinated seed collected from 310 "mother trees" from throughout Wisconsin were established in 1970 at Avoca (Iowa County), Lake Tomahawk (Oneida County), and Ten Mile Creek (Wood County). These seed orchards were thinned in 1980 and again between 2004 and 2006 to retain the tallest families and best-formed trees for seed production. Now 44 years old, the orchards are starting to decline requiring the creation of new, second generation orchards to provide a red pine seed source into the future.

The current seed orchards established in 1970 at a north, central, and southern location were intended to provide seed for the State Reforestation Program in the event that Wisconsin might be divided into separate breeding zones. Current information indicates that this is unnecessary and that Wisconsin can be considered one seed zone for red pine. With this knowledge, the decision was made to create a single second-generation orchard composed of the best selections

from all three existing orchards. To accomplish this, the 'best' individuals from within the tallest 125 families at each orchard were identified during 2003-2004. Between 2004 and 2009, open-pollinated cones were harvested from these trees as they became available. Seed from the best 185 of these families were sown in the Forest Genetics greenhouse at the WDNR South Central Region headquarters during the winter of 2013. Some 158 of these families germinated in high enough numbers to be out planted into nursery beds at Wilson State Nursery in June of 2013 (Figure 3). These trees will be lifted in the spring of 2015 and planted into beds at the WDNR's Hayward State Nursery facility to create a new 2nd generation red pine seed orchard.

White Spruce

White spruce tree improvement efforts continue to focus on the intensive management of seed orchards and the evaluation of progeny tests in order to supply improved seed for the State Reforestation Program. While the program manages four orchards located in central and northern Wisconsin, the two youngest orchards are the main focus. These orchards are both located on WDNR wildlife area properties; one in the Mead Wildlife Area (Marathon County) and the other in the Sawyer Creek Wildlife Area (Washburn County). Planted in 1982, the six-acre Mead white spruce seed orchard consists of 175 families drawn from elite material selected by the USDA-Forest Service (USFS) primarily from the Ottawa Valley, Ontario along with a few selections from Quebec and Wisconsin. In the past 5 years a dense understory of Canadian elderberry (*Sambucus nigra*) has exploded within the orchard making access extremely difficult. Over the summer, Tree Improvement staff mowed off the elderberry understory but further control will be needed in the future to prevent it from regaining a choke hold on the understory. The 10-acre Sawyer Creek progeny test planted in 1989 contains an additional 168 different families selected by the USFS throughout the Lake States region and the Ottawa Valley of Ontario. Extensive thinning has been completed within both seed orchards during the last five years by program staff. The thinning process retains the best individuals within each family and allows for access by a lift truck for cone harvesting. Unfortunately, there were no cone crops large enough to justify collections at any of the white spruce orchards in 2014.

In early November, 500 two-year old white spruce seedlings were selected and hand dug at Wilson State Nursery to be used as rootstock for grafting. During the winter they will provide understock for scion wood from the 'best' individuals at the Sawyer Creek orchard. Grafting will occur at the Forest Genetics greenhouse at the WDNR South Central Region headquarters. This will begin the process of creating a clonal seed orchard to be sited at the Hayward State Nursery facility.

Black Walnut

While Wisconsin is on the northern edge of black walnut's (*Juglans nigra*) range and its natural distribution has been historically limited to the southwestern one-third of the state, black walnut remains a species of great importance to landowners and the forest products industry in southern Wisconsin. Earlier research indicates that, at the northern margin of the species range, winter injury regularly occurs on trees from sources moved more than 100 miles north of their origin, though this may be shifting as the climate warms. At present the program is limited in scope and focused on selecting superior quality trees in natural stands from Wisconsin and northern Illinois. Scions from those trees are then grafted into a clonal seed orchard at the Kickapoo River Wildlife Area, Bell Center Unit (Crawford County). An additional thirty-eight grafts from eight selections originating in Iowa, Grant, Jefferson, and Richland Counties were added to the seven-acre Bell Center clonal seed orchard during the spring of 2014. Many of the trees in the orchard, some of them as tall as 20', were pruned during the spring to improve form

and to allow for better equipment access. The orchard serves to both conserve the limited genetic resource of black walnut that is adapted to Wisconsin and to provide future sources of improved seed for the State Reforestation Program.

Figure 4: Staked butternut Hayward State Nursery, Summer 2014. (Photo WDNR)

Butternut

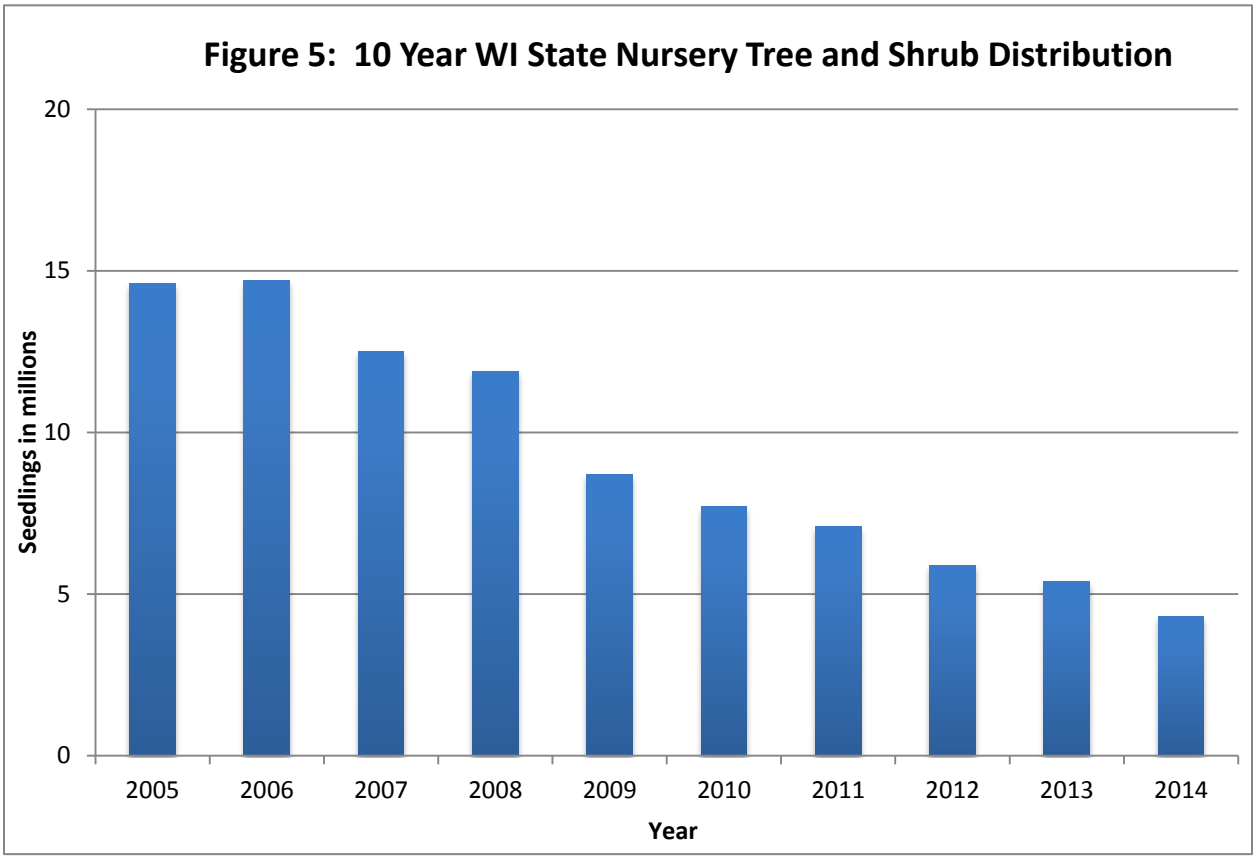
Butternut (*Juglans cinerea*), a close relative to black walnut and often referred to as white walnut, has been declining in Wisconsin since the exotic butternut canker disease (*Ophiognomonia clavigignenti-juglandacearum)* was first reported here in 1967. Trees infected with the fungus develop branch 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 quality lumber as well as its nuts for both wildlife and human consumption.

Beginning in the 1980's, an increasing number of canker-free trees have been identified (mostly by the USFS) growing alongside infected trees throughout butternut's native range, including in Wisconsin. While tolerance or genetic resistance to the disease has yet to be confirmed, putatively disease-free trees from infected areas have been screened by the USFS and demonstrate wide variation in susceptibility to the disease. Recent studies have shown a high level of genetic diversity present within the species across its range. An additional obstacle compounding the selection and re-introduction of disease-resistant butternut is its ability to hybridize with Japanese walnut (*Juglans ailantifolia*). Since Japanese walnut's first introduction into the United States in the 1860's, naturally-occurring interspecific hybrids and backcrosses between the two species have been found across much of butternut's native range. Designated as *Juglans X cinerea*, these complex hybrids are more productive, vigorous, and disease-resistant than butternut while maintaining the appearance of butternut. Due to their near identical appearance, using morphological traits to distinguish between pure butternut and the hybrid is difficult. Fortunately, the identification of DNA-based markers has made it possible to positively distinguish between the hybrid and the species. Once a putatively disease-free tree is identified, scions from the tree are grafted into a clone bank. Black walnut, a close relative of butternut, is used as rootstock given its resistance to the disease, thus eliminating possible infection of the graft from the rootstock.

The Tree Improvement Program has partnered with the USFS to establish a butternut genetic conservation project. In the spring of 2013, seventy-nine putatively disease-resistant, grafted 'pure butternut' clones were planted at the Hayward State Nursery facility. These clones

represent 14 selections made in five different Wisconsin counties together with two selections from two bordering Minnesota counties. The selections and clones were made by staff from the USFS's Oconto River Seed Orchard (ORSO) and the USFS's Hardwood Tree Improvement and Regeneration Center (HTIRC) in West Lafayette, Indiana. Additionally, HTIRC provided 74 seed derived progeny drawn from 20 selections originating in Wisconsin. These seedlings were out-planted at the Kickapoo River Wildlife Area, Bell Center Unit (Crawford County) in 2010. Research is currently underway by USFS scientists to measure variation in resistance to butternut canker as well as to define the heritability of any resistance traits in offspring. During the summer, Tree Improvement staff with assistance from Hayward nursery personnel staked 20 trees to encourage better form and improved branching (Figure 4). In the fall an additional 6 Wisconsin clones were received from ORSO to be added to the Hayward orchard in spring, 2015, along with another 5 Wisconsin clones from HTIRC.

2014 Reforestation Program Highlights



The State Nursery Program, established in 1911, was renamed the Reforestation Program during 2014, to reflect the fact that the program provides multiple services in addition to seedling production. The Reforestation Program is committed to continuing to produce high quality, well-adapted tree and shrub seedlings for the entire state. In 2014, the program distributed a total of 4,338,312 bare-root seedlings and shrubs. Since the program's inception in 1911, a total of more than 1,610,090,572 seedlings have been distributed. Approximately 77% of the 2014 distribution total consisted of conifers with the balance made up of hardwoods and shrubs. Of the paid orders, 70% were distributed to private landowners followed by 26% to county forests.[1]

Table 2: Forest Nursery Production by State

STATE	1998	2012	2013	2014
Iowa	3,726,000	1,857,450	896,700	869,900
Illinois	5,650,000	1,761,215	1,387,915	1,255,260
Indiana	6,000,000	5,191,691	3,698,439	3,833,891
Michigan	33,799,000	20,928,300	13,889,350	8,280,550
Minnesota	25,500,000	19,199,275	12,912,110	6,176,000
Missouri	7,545,000	4,862,275	4,548,561	1,893,275
Wisconsin	28,925,000	15,840,250	12,579,145	8,346,771

TABLE 2: Selected nursery production data drawn from v.49 (1998), v.55 (2012), v.56 (2013) and v.57 (2014) of USDA-Forest Service Tree Planters' Notes. Totals include seedlings imported from Canada.

The 10-year trend (Figure 5) for Wisconsin nursery distribution shows a continuing decline in trees and shrubs sent to customers. This trend is similar to what is being seen throughout the region (Table 2).

[1] Data source: State Nursery Tree Distribution & Tree Planting Report 2014, DNR

Several factors account for this decline including, declines in federal cost-sharing programs that reduce incentives to plant trees, property taxes on recreational land, changes in large (industrial) land ownerships across the state, county forest partners shifting to containerized stock from other sources, and agricultural commodity price increases leading to land remaining in (or re-entering) agricultural production..

Seed collection varied greatly this year and was likely impacted by the extremely cold winter of 2013-14. While red oak, black cherry and walnut seed crops were very good, white oak, bur oak, swamp white oak, shagbark hickory, sugar maple and basswood were fair to poor, with only occasional pockets of good seed production if any. This meant not meeting seeding goals for white oak and shagbark hickory but with species like maple and basswood, there were good inventories in storage, and seeding goals were not impacted. Shrubs species varied greatly as well, but good inventories also allowed for most seeding goals to be met.

Wilson Nursery

The year started out with one of the coldest winters on record. Fortunately, there was also a thick, insulating snow cover on the nursery beds which both protected the nursery stock and minimized ground frost depth. With the stock in good shape and frost depth minimal, spring distribution started out relatively normal on March 28th and continued until completion in late April. Spring weather remained cool throughout the season and allowed for 2 million seedlings to be lifted under dormant conditions. Of these, 1.76 million seedlings were graded while the remaining quarter-million were shipped as bulk orders. The nursery's ongoing partnership with the nearby Department of Corrections, Boscobel Secure Program Facility, continued as they assisted with grading about 385,000 seedlings in 2014.

As part of the spring seedling distribution, about 2,000 two-year-old American elm (*Ulmus americana*) seedlings were distributed as part of a partnership with the USFS on an American elm project designed to introduce Dutch elm disease tolerance/resistance genes into native elm populations. Seed was collected by the USFS from putative disease resistant trees of American elm and supplied to the Wilson Nursery. The stock was sown in 2012, grown to desired seedling size, and distributed in the spring to partners in the USFS, Wisconsin DNR, Army Corps of Engineers, Iowa DNR, Minnesota DNR, and the Southwest Badger Resource Conservation & Development Council. These agencies used the seedlings to establish trial out-plantings to assess how two-year-old stock performs under normal reforestation conditions. Results will be compared to that collected for the one year old stock established in out-plantings last year.

The growing season started out relatively cool and wet and most species germinated about a week later than normal with walnut and hickory not germinating until mid-May. While germination was good for most species, sugar maple was a complete failure and had to be reseeded in mid-June after the seed completed a 30-day cold stratification. On the whole, the growing season remained cooler than average. To counteract this, adjustments were made to fertilizer prescriptions and all stock was able to meet quality seedling specifications by the end of the growing season.

Wilson Nursery continues to improve its Integrated Pest Management program using carefully timed fumigation, a variety of herbicides, proper plant nutrition, and hand weeding when needed. For the second year, the nursery was able to eliminate the need to hand weed in walnut beds and drastically reduced the need for hand weeding in much of the 1-0 seedling

crop with proper fumigation and appropriate herbicide regimes. All 1-0 seedbeds were fumigated with metam sodium soil fumigant which resulted in effective weed control throughout the season, unlike the previous year when a portion of the seedbeds were fumigated with Chloropicrin resulting in less efficient weed control. Overall, weed control was very manageable during the 2014 growing season. The combination of fumigation, an application of glyphosate to kill the winter wheat cover crop and early spring weeds, coupled with pre-emergent herbicide treatments followed by a small hand weeding crew did a great job.

Wilson Nursery staff continued last year's trials with planting aspen root cuttings to generate aspen seedlings with about 10,000 saleable seedlings being produced in 2014. Root sections varying from about 1½ to 4 inches long were spread by hand down a 1" to 1½" deep furrow and then covered. Although root length did have an impact on initial seedling size and stand density, at the growing season's end the seedling size and density balanced out. While the shorter roots initially produced fewer and smaller sprouts than the longer roots, over the course of the summer the high density of sprouts in the longer root sections thinned down, while the sprouts from the smaller roots caught up in size. This was most likely due to the differences in competition within the two plantings. The seedlings will be made available for distribution in the spring of 2015.

Wilson Nursery prepared about 8 acres of nursery beds for fall seeding. This included peat moss additions to adjust soil organic matter levels and fertilizer amendments to adjust soil nutrient levels. Following this, the beds were fumigated with metam sodium for both weed control and soil disease management. Fall seeding was completed by mid-October on 7.75 acres with the remaining 0.25 acres to be completed in the spring of 2015. Winter wheat was sown as 'living mulch' in all hardwood and shrub seedbeds in place of hydro mulch applications, providing a considerable cost savings while still protecting seed. Trials with winter wheat continue on conifer beds, especially white spruce, with the goal to replace shade cloth currently used to shield young seedlings. Trials have been conducted over the last four years with some success, but the process continues to be fine-tuned to gain consistency and ensure a successful crop.

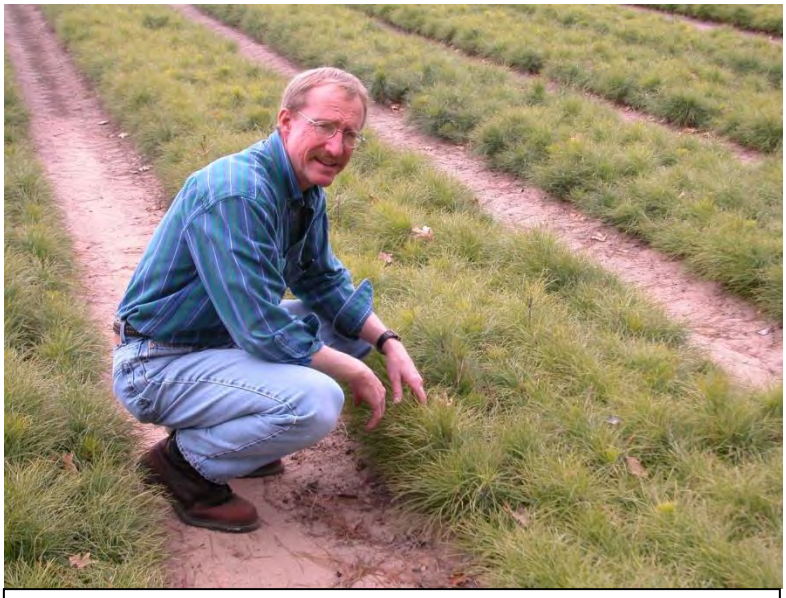


Figure 6: Jim Storandt, Griffith State Nursery manager Inspecting white pine seedlings (Photo WDNR)

Griffith Nursery

The Griffith State Nursery, built in 1932 during the Great Depression with the help of members of the Civilian Conservation Corps, has produced and distributed tens of millions of tree and shrub seedlings to regenerate thousands of acres of forest land in Wisconsin. In early December, the DNR made the hard decision to consolidate future seedling production at the Wilson State Nursery in response to a significant decline in the sale of nursery stock within the state. The Griffith Nursery will complete the production of seedlings currently in the beds and distribution will carry on as normal for the spring of 2015. Although seedling

production will be ending in the next few years, the nursery will continue to play a key role in the Department's Reforestation Program. The DNR Division of Forestry will continue to evaluate other opportunities to further utilize the facility in the future.

Along with this change, Jim Storandt, Griffith State Nursery manager, retired December 1, 2014 after 29 years of leadership and devotion to reforestation in Wisconsin (Figure 6). Under his tutelage nearly half a billion conifers, hardwoods and shrubs were produced and distributed to customers in Wisconsin.

The winter was one of the coldest, snowiest and longest in quite some time. Luckily, a persistent 15"+ inches of snow insulated the tree and shrub seedlings, allowing them to enter the spring in great condition. The cold weather spilled over into spring and kept the nursery from lifting seedlings until the 2nd week in April. Persistent frost in the 2-0 and 3-0 conifer nursery beds, along with a freak 6" snow squall on April 13th, inhibited lifting these conifers until the 3rd week in April. While lifting, grading and packing of orders was completed by early May, stock distribution continued until just prior to Memorial Day. While sometimes frustrating, the cool, cloudy weather conditions ensured that all stock was lifted while dormant. In all, Griffith nursery distributed over 1.61 million graded seedlings and over 737,000 bulk seedlings in 2014.

The growing season started out cool and wet, causing most species to germinate a little later than normal. On a whole germination was good, especially for white pine which required row thinning to decrease densities. A few species suffered setbacks; sugar maple, white birch, and ninebark germination were failures. Black cherry and some other shrub species germinated, but in densities far below normal levels. The two-year germinants, basswood, highbush cranberry and winterberry, germinated much better than anticipated, with the basswood achieving marketable size in a single season. While the growing season remained cooler and wetter than average, both new and existing stock did well.

Nursery staff remained busy throughout the summer tending seedlings, maintaining the property and providing training to new DNR foresters. A mix of herbicide treatments, proper fertilization and hand weeding when needed kept weeds under control. A new practice of drilling rows of winter rye along with conifer seeding to control weeds and provide shading for the newly germinated seedlings seemed to be successful. Though it showed promise, further evaluation will be needed to confirm whether or not it is worth continuing the practice in future years. A new initiative to rid the historic nursery property of invasive species proved to be very successful. Grape vines, honeysuckle, buckthorn and other undesirable species were removed. The nursery also hosted two separate training sessions for over 40 newly hired DNR foresters. Training topics included seed identification, seedling care, nursery practices, herbicide application, as well as planting equipment upkeep along with practical demonstrations on seedling grading and planting.

The nursery staff continued their history of experimentation by looking into aspen seedling production, using both seed and root sections. Seed were mixed with Malt-o-Meal breakfast cereal to act as a carrier due to the seeds tiny size and planted just barely below the surface. The aspen root sections, supplied by Wilson Nursery, were planted by hand in trenches approximately 1" deep. The seed was covered with rye straw, bed boards and shade cloth covered wire screen while the roots were not covered. While the seeding was a complete failure, the root sections proved to be very productive, generating over nine thousand 8-10" aspen seedlings which will be distributed in spring 2015.

Hayward Nursery

Hayward State Nursery continues as a spring tree seedling distribution center for public and private customers in the north. The nursery also continued its role as the conifer seed extraction facility for the Reforestation Program, focusing primarily on jack pine and balsam fir in 2014. Approximately 1,100 bushels of jack pine cones and 22 bushels of balsam fir cones were dried, their seeds extracted, cleaned, and put into cold storage for future use in both seedling production and direct seeding. The two new Bayfield County jack pine buying stations established in 2013, at Barnes and at Washburn, in partnership with the State Reforestation Program, continue to be very successful and helped to significantly increase the amount of jack pine purchased in 2014. Hayward also continues to maintain the Reforestation Programs statewide seed storage operations. Duties performed by staff include preparing seed for proper storage by measuring moisture content, performing periodic germination tests, sizing seed to improve uniformity in the nursery beds, preparing seed for customers, and filling seed orders.

UW-Superior partnered with the Hayward Nursery to establish a highbush cranberry field trial at the nursery over the summer following the successful establishment of a hazelnut field trial in 2013 with UW-Extension, Bayfield County. Nursery staff prepared the field for the trial, grew the seedlings and established the planting. While the hazelnut study was established to look at nut production, the highbush cranberry study is looking at opportunities for the species to be used in biofuels and pharmaceuticals. Hayward Nursery staff also assisted with the establishment of a Tree Improvement Program jack pine seed orchard at the nursery during 2014. Staff ensured the successful establishment of both plantings by providing weed control and irrigation throughout the growing season.

The 24-acre prairie grass seed production area planted in 2013 is developing well and is expected to produce harvestable seed within the next 3-4 years. Prairie grass species include Indian grass, switch grass, little blue stem and big blue stem. These plantings act as a long term cover crops as well as a potential prairie grass seed sources for the DNR.

The Reforestation Program's herbicide trial moved into its second year with results being tracked to assist in developing future recommendations for landowners; this project will continue for at least one more year. This trial was generated in response to questions generated by the statewide reforestation monitoring surveys conducted over the last seven years concerning herbicide application rates and impacts on seedling survival. As a result, a three-year Oust herbicide trial was put in place at Hayward. Thirty-two nursery bed rows containing a winter wheat cover crop were planted with 15 plants each of 25 various conifer, hardwood, and shrub species. Oust XP was then applied at 0.5, 1, 2, 3, and 5 ounces/acre. Plant impacts will continue to be monitored through next year. In the fall, the property was utilized for a site preparation equipment demonstration for department foresters from the northern district and for department ATV safety training.

Reforestation Monitoring

Introduction

In the summer and fall of 2014, the state nursery assistant managers and their staff visited 197 1st year monitoring sites (Wilson-74 and Griffith-123), 73 3rd year monitoring sites (Wilson-35 and Griffith-38) and 15 7th year monitoring sites (Wilson-10 and Griffith-5) to assess the success of new tree and shrub plantings made using DNR nursery stock. These sites were scattered throughout all regions of the state on both public and private properties. To increase landowner contacts over a larger geographic area the nursery system hired three limited term employees (LTE).

Weather Conditions

Planting and growing conditions were more uniform statewide than in recent years. The season started extremely late as very cold and snowy conditions in March and April delayed nursery stock lifting and delivery until late April and mid-May. The weather stayed cool and wet, providing ideal conditions for planting and early season tree health. A few small areas of the state experienced some minor periods of dry conditions, but overall seedlings had good conditions for their first growing season. Weather remained favorable into the autumn so seedlings should have entered the winter in very good condition.

Landowners

As in years past, the majority of seedlings ordered are planted on public property, especially state forests or other state owned lands and county forests. However, the majority of sites visited are owned by private landowners. These folks are very open to discussing and exhibiting their plantations and many asked to be included in the site visit. These requests are accommodated whenever possible, regardless of the challenges associated with coordinating schedules. Nevertheless, what is lost in efficiency is made up for in positive public relations.

Plot Data

Wilson Nursery – 2014 Planting Surveys - Roger Bohringer

Figure 7: Serious ragweed competition Grant Co. private landowner
Photo by Roger Bohringer, WDNR

The 2014 monitoring season got off to a slow start. The common practice is to wait at least 4 weeks after planting before surveying a site to give the stock time to acclimate and begin growth. With the late spring thaw, the planting season extended through the entire month of May, so sampling didn't begin until July. As a result, July and August found LTE forester Jamie Rupple in the field nearly every day. He arranged visits with 59 landowners/property managers, many of whom had multiple planting sites to survey. By summer's end we had surveyed 74 1st year plantings

across the southern and western part of the state (Barron-4, Burnett-6, Chippewa-1, Columbia-3, Crawford-3, Dodge-2, Dunn-5, Grant-4, Green-3, Iowa-1, Jackson-2, Jefferson-3, Milwaukee-1, Monroe-1, Ozaukee-2, Pierce-2, Polk-3, Richland-3, Rock-2, Sauk-5, Sheboygan-1, St. Croix-3, Trempealeau-5, Vernon-5, and Washburn-5).

Figure 8: Nice 1-0 Jack Pine Washburn Co. Forest
Photo by Roger Bohringer, WDNR

Most plantings were successful, aided by the cool spring, mild summer and well-timed periods of rainfall. Many trees in the south were planted into heavy sod or old agricultural fields, and some of these plantings were in need of emergency release spraying (Figure 7). The late spring and wet conditions appear to have caused poor pre-emergent herbicide performance, or prevented spraying entirely. Typically the program recommends a herbicide application of clopyralid and clethodim for these situations. Both can be sprayed over non-dormant stock without causing serious injury.

Figure 9: Wild blueberries Burnett County Forest
Photo by Roger Bohringer, WDNR

In the north, red pine and jack pine plantations going into cutover areas looked great (Figure 8). Several large orders were shipped from the nursery with the roots already pruned and ready to plant. This stock appeared to be well handled and planted, resulting in excellent survival and growth, with the exception of some locally moderate losses due to root feeding insects. As an added bonus, site visits in Burnett County came during the peak of a banner year for blueberries (Figure 9).

2012 Plantings

Of the sixty-seven 2012 plantings in the Wilson distribution area with 1st year data, several were known to be failures due to the drought of 2012 and were replanted in 2013 with Wisconsin Forest Landowner Grant Program funding. Of the successful 2012 plantings, 35 were visited in the fall to assess 3rd year survival and growth (Bayfield-3, Burnett-4, Crawford-4, Grant-3, Lafayette-1, Monroe-4, Polk-4, Richland-2, Sauk-1, Sheboygan-5, Trempealeau-2, and Washburn-2).

Overall, the conclusion reached for the 2012 plantings is that you get out of it what you put into it. Plantings that had received some follow-up mowing and release spraying were faring pretty well. Those that landowners walked away from were struggling against the competition. Some interesting details from the 3rd year data include that of the 1937 seedlings assessed, the tallest were a pair of black cherries at 106" and the shortest was a 2" white pine in heavy weeds. The average height across all species was 22.8". Average 3rd year heights for commonly planted species were swamp white oak

33.4”, black walnut 24.6”, white pine 25.7”, jack pine 25.9”, red pine 15”, white spruce 15.7”, red oak 19.6”, and shagbark hickory 9.5”.

Figure 10: Vigorous 7 year old White Oak terminal bud Devil’s Lake State Park
Photo by Roger Bohringer, WDNR

2008 Plantings

The regeneration monitoring program made a strong effort to assess more 7th year plantings in the Wilson distribution area during 2014 (Figure 10). Fifty-one plantings from the spring 2008 planting season had 1st year assessments. While southern Wisconsin suffered from severe drought in 2012, the region experienced severe flooding during the 2008 summer, especially along the Wisconsin and Rock River corridors. Several plantings in the region were completely washed away or were buried under a thick silt layer shortly after planting. As a result, only ten 2008 plantings were visited this fall to assess plantation success (Sheboygan-3, Ozaukee-1, Monroe-2, LaCrosse-1, Vernon-1, Sauk-1, and Waukesha-1). Three of these plantings were assessed in the fall of 2010 as 3-year-old plantings. Stocking rates ranged from 167 trees/acre on a poorly maintained white pine planting, to 1367 trees/acre on a high density hardwood planting on DNR property. Four plantings were stocked at less than 300 trees/acre, and by most standards would be considered failed plantings. Some interesting details from the 7 year data include that of the 509 seedlings assessed, the largest was a 216” tall red oak, with the smallest being a 6’ stump sprout from a repeatedly girdled white oak. The average height across all species was 75.3”. Average 7th year heights some more commonly encountered species were white pine 99.4”, red pine 75.3”, jack pine 117.4”, white spruce 47.5”, red oak 66.1”, white oak 60.9”, bur oak 64.4”, and shagbark hickory 22.3” (only 6 counted).

Figure 11: 2014 planting Marquette County private landowner
Photo by Emily Boden, WDNR

Griffith Nursery – 2014 Planting Surveys – Jeremiah Auer

Most of the 1st year sites were visited by Griffith nursery LTEs, Michael Filtz and Emily Boden. After a short training in mid-May, the pair visited 123 plantations (Adams-6, Burnett-3, Calumet-1, Clark-3, Door-1, Douglas-1, Forest-2, Fond du Lac-19, Green Lake-1, Juneau-2, Kewaunee-3, Langlade-3, Lincoln-5, Manitowoc-4, Marathon-4, Marinette-15, Marquette-4, Monroe-1, Oconto-2, Oneida-1, Portage-6, Price-1, Rusk-2, Sawyer-1, Shawano-6, Taylor-1, Vilas-8, Waupaca-3, Waushara-5, and Wood-5). A few state and county properties not typically known for planting established a number of plantations in 2014. This enabled nursery staff to travel to new corners of the state and interact with new forest managers and landowners. Overall, the plantations established in central, eastern and northern Wisconsin were planted later than usual due to the cold spring. Soils were cool and moist and provided an ideal environment for seedling establishment. Scattered rains fell throughout the summer and the cooler than normal conditions provided a good environment for growth and development. Competition was relatively well controlled area wide; most seedlings experienced only minor grass and forb competition (Figure 11). However, some of the larger state and county plantings struggled with planting depth. While this problem will not impact the seedlings in the early years of growth, it tends to become a problem a few years after planting. Overall, seedling survival was good and the plantations should do well.

Figure 12: 2012 planting Oneida County private landowner
Photo by Emily Boden, WDNR

2012 Plantings

The 2012 year was a difficult time to establish tree plantations in the southern 2/3 of the state. A very early spring gave way to a record breaking dry summer that only relented in early autumn. The long, cold, snowy winter and spring of 2013 seemingly offered a reprieve, but for many seedlings it was too late. Seedlings in the north had a much better season as rain fell frequently and the temperatures were warm. Originally,

nursery staff visited 97 sites in the summer of 2012, of those, 20 sites were revisited in their third growing season. (Adams-1, Brown-1, Clark-2, Door-1, Douglas-4, Florence-2, Fond du Lac-1, Green Lake-3, Juneau-2, Kewaunee-1, Lincoln-3, Oneida-2, Outagamie-2, Portage-2, Taylor-1, Vilas-5, Waupaca-2, and Waushara-3) Overall, the sites fared quite well considering the challenges they endured early in their lives. Of these sites, five had over 50% mortality and require a major replanting effort. These sites were found on drought prone soils. A few other sites with high mortality, however, were caused by excessive moisture. A number of the sites had very high weed competition; however, this did not seem to impact growth and establishment (Figure 12). In the same manner, the sites with substantial hardwood components suffered from deer browse. The larger plantings on the public lands in the north, whether or not actively managed for competition, have done very well. Overall, the northern Wisconsin plantings fared much better than those in the southern portion of the state. However, the plantings in southern Wisconsin have done much better when landowners invested more time into their development.

2008 Plantings

This was the second year that nursery staff have been able to visit plantations after the 7th year of growth. Originally, nursery staff visited 78 sites in the Griffith distribution area and 5 of these sites were revisited in 2010 (Door-1, Fond du Lac-1, Manitowoc-1, Outagamie-1, and Portage-1). The sites represented a diversity of soils, weed competition, landowner interest and growth. The sites that did the best were, not surprisingly, those planted on better soils with at least a moderate level of landowner maintenance (Figure 13). However, even those with high competition and on poorer soils did quite well. One site underwent a change in ownership and while not well maintained, still managed to produce some very good looking saplings. Overall, each one of the sites met the nursery criteria of seedlings being free to grow after seven growing season.

Figure 13: Fond du Lac County private landowner Photo by Emily Boden, WDNR

Future Considerations

The Reforestation Monitoring Program has been collecting data from tree plantations since 2007. In that time, it has amassed data on tens of thousands of individual seedlings planted on the Wisconsin landscape. This data and subsequent analysis has allowed the program to review and then refine its current data collection protocols. As the program continues into the future, it will be amending current recording practices and preparing to distribute nursery findings to colleagues and customers.

Conclusions

2014's long, cold, snowy spring provided ideal conditions to plant seedlings, albeit much later in the spring than usual. The cooler summer weather that followed was conducive to seedling establishment and growth. Consequently, most newly established plantations did well this year and should be prepared to enter the winter well equipped to thrive in the spring of 2015.