

Wisconsin's Reforestation Programs 2016 Annual Report



Redheaded Pine Sawfly larvae (*Neodiprion lecontei*) on jack pine progeny test at Hayward Nursery – July 2016

**Wisconsin Department of Natural Resources
Division of Forestry
Reforestation Program**

and

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Introduction

The Wisconsin Department of Natural Resources' (WDNR) Reforestation Program is comprised of three linked efforts:

- 1) **The Reforestation Monitoring Program** monitors reforestation efforts, primarily through the periodic assessment of seedling survival, growth, and long-term health and productivity. The information learned from this data is used to inform tree growers on the best planting strategies for producing optimal reforestation results;
- 2) **The State Forest Nursery Operations** produces and ships forest tree seedlings for reforestation purposes to customers throughout Wisconsin. Seed is also sold to private nurseries for production of tree seedlings for reforestation in Wisconsin;
- 3) **The Tree Improvement Program (TIP)** is a WDNR collaboration with the UW-Madison Department of Forest and Wildlife Ecology to conduct forest genetics research and 'applied tree improvement' via the establishment of tree seed orchards and supporting progeny tests. The trees in these seed orchards have been selected for superior performance and for being well adapted to Wisconsin growing conditions. Seed from the seed orchards is utilized by the State Reforestation Program.

2016 Tree Improvement Program Highlights

In 2016, we focused on improving the management status of many of the active seed orchards and progeny tests. Deferred maintenance and the removal of invasive saplings in five seed orchards/progeny tests was accomplished, as well as the installation of a new deer fence at our Bell Center Hardwood seed orchard, and an initial thinning of the large white pine progeny test at Lake Tomahawk. Other highlights for the year include a cone harvest from the jack pine seed orchard at Greenwood, and collection of 5-year height data and gall rust scores for the Black River Falls jack pine progeny test/seed orchard. Additionally, there has been ongoing collaboration with USFS staff at Rhinelander and Oconto River to share information and expertise concerning their long-term white spruce tests.

The following is a more detailed description of the major accomplishments in the Tree Improvement Program in 2016.

Bell Center Fence - Soliciting bids for replacing the rapidly deteriorating plastic deer fence surrounding the Bell Center Hardwood seed orchard was begun in early spring. The accepted bid from Straight Line Fencing received final approval in September. Site preparation for the new fence was performed by Stuart Seaborne, with substantial assistance from DNR staff at Wilson Nursery. This work included temporary fence repair in the summer, spraying the fence line with herbicide to kill established brush, vines, and other weeds, and removal of the plastic fence and T-posts just prior to installation of the new fence. Construction was delayed due to wet site conditions and a late harvest of corn and soybean fields, some of which were inside the perimeter of the seed orchard site. The work was completed over two days in early December just as the winter freeze set in for good. Site clean-up from this project needs to be completed in early spring, or as winter conditions allow.

The new fence will protect the trees that are there now (mostly grafted black walnut and butternut seedlings) from buck rubbing and browsing. In addition, it also increases the protected area within the fencing by one acre. Potential uses for this additional protected area will be considered at the winter meeting.

Mowing the understory grasses and invasive hardwoods in the orchard was completed in the spring and fall of 2016 using a tractor brush-hog.



New woven-wire fence being built at Bell Center – December 2016

Lake Tomahawk White Pine Thinning - Planted on 15 acres on the Northern Highland American Legion State Forest near Lake Tomahawk in 2002, this white pine progeny test is a companion planting to one located at Black River Falls. It originated from seed of 256 families collected in the same natural populations as were propagated at Black River Falls. The original Lake Tomahawk planting contained approximately 10,000 trees which had not been thinned previously. The planting was in danger of being lost as a potential seed orchard if thinning was not done this year. The marking for this thinning was designed to retain the top 20% of the families (based on height growth), plus representation of the other families.

Starting in May of 2016, a Bobcat with a Fecon head, operated by Michael Ard, an LTE for the DNR based at Griffith Nursery in Wisconsin Rapids, was used to thin out the poorer performing trees. Thinning with the Fecon began in May before Michael's reforestation monitoring duties required him to halt. Work resumed in November, but mechanical issues and cold weather delayed completion of the initial thinning until January of 2017.

Another round of tree removal is needed here to achieve optimal seed orchard spacing while the trees are still small enough to continue use of the Fecon. Starting in early 2017, the planting will be re-marked for additional thinning (approximately 20% of the remaining trees), with the Fecon work to be done later in the spring.



White pine progeny test at Lake Tomahawk being thinned by Fecon – May 2016

Greenwood Jack Pine Cone Harvest – Greenwood is a 2nd generation jack pine seed orchard that was planted in 1997 on 4.5 acres in Waushara County. At 20 years of age, the trees are in good health and entering their peak cone producing years.

The orchard was mowed with a tractor brush hog in July of 2016. At the very end of August, a cone harvest was completed using pole pruners to snip off the ends of branches with cones. Over 6 bushels of cones were harvested with help of staff from Griffith Nursery. Once processed at Griffith, the cones were sent to Hayward Nursery for seed extraction.

The jack pine trees at Greenwood are getting taller than is desired for managing as a seed orchard. Included in the 2017 Work Plan is a potential topping of the trees by removing one or more central leaders or main branches. This would be followed by a cone harvest from the cut tops. Pruning the trees in this manner is done to encourage cone production on the lower branches, where they are easier to harvest from the ground.

Black River Falls Jack Pine 5-year Height and Rust Scoring – These jack pine trees form a 3rd generation ‘index population’ and were planted in 2011 on 5 acres in the Black River State Forest. They include progeny from crosses among the ‘best’ trees identified in the Hancock and Ten Mile II ‘index populations’. Sometime in late 2014 or early 2015, a strong windstorm bent over many of the tallest trees, being especially susceptible to wind throw due to their relatively larger size.

Fifth-year height was measured, and pine-oak gall rust (*Cronartium quercuum*) scored, in the spring of 2016. We also updated our inventory of surviving trees, provided form scores for each tree, and noted the extent of tip weevil impact. Stuart Seaborne and Michael Ard collected this data, which is currently being analyzed to identify the tallest 50% (approximately) of trees in the planting. Rust scores will be combined with other metrics to select which jack pine families and trees to retain when we conduct an initial thinning. The 2017 Work Plan schedules this marking to be conducted in March. The actual removal work using a Fecon will probably not occur until late fall, 2017, at the earliest.

Mowing of the site was completed during the fall of 2016 using a walk-behind brush hog within the tree rows. The perimeter was mowed by a tractor-drawn brush hog.

Understory Control – Mowing was done at the Bell Center Hardwoods (twice), the Greenwood jack pine, and the jack pine at Black River Falls in 2016. These sites contain mostly grasses with brambles and scattered small saplings as understory, and mowing is needed to keep the sites accessible and to minimize competition for the trees. However, other orchards in the program had a more established understory of volunteer tree saplings, requiring more labor-intensive control efforts.

The Ten Mile II jack pine spacing was too tight for use of a tractor- drawn brush hog, and the understory was thick with saplings threatening to overwhelm the site. Much hand lopping was done in the spring to provide some control, but eventually a walk-behind brush hog was made available in October, enabling us to mow most of the orchard.

The red pine seed orchard at Lake Tomahawk, planted in 1970, and a sister orchard to the red pine planting at Ten Mile, had understory removal performed during 2016 to cut out invading saplings. We anticipate a future cone harvest here, one that will involve felling trees to facilitate cone harvesting, making it important to control invasive saplings. There was an opportunity to provide understory control in the red pine simultaneous to the white pine thinning project being completed at an adjacent location. Many volunteer saplings in the red pine were 7 feet tall or taller, and removal was needed before they got any larger. Between spring, fall, and winter work, 80% of the understory has been removed through hand lopping. The remainder will be completed in May of 2017.



Before and after mowing the Ten Mile II jack pine seed orchard – October and November 2016

Overview of Tree Improvement Program 2017 Work Plan

A detailed Work Plan that outlines specific tasks to be accomplished, and projects where assistance from the Reforestation Program is requested for 2017, has been submitted to the WDNR as part of the State Reforestation Program. Below is a summary of the primary Tree Improvement goals for 2017 as noted in that report.

We need to prepare for a potential white spruce cone harvest in 2017, if flowering and cone formation at the three mature white spruce seed orchards located at Lake Tomahawk (Oneida County), Mead Wildlife Area (Marathon County), and Sawyer Creek (Washburn County) warrants. The WDNR seed inventory for white spruce is low, and there has been no significant cone crop in the last two years. However, a cone harvest at these sites is impractical due to the trees' size unless some trees are felled. Careful planning, site preparation, and sufficient labor are needed if this is to be done successfully. Cone formation will be monitored this spring and early summer, and the orchards will have the understories mowed to prepare for a harvest.

The jack pine seed orchard at Greenwood (Waushara County) needs to have the trees topped to control their height and confine the cone production to the lower branches. At this time, a cone harvest would be done as well. This orchard is an important source of improved jack pine seed, and makes proper management a priority. Again, good coordination with the Reforestation Program, and organizing the resources to do the work, are necessary to complete this successfully.

Jack pine has the highest potential for genetic improvement of any of the tree species we work with. The trees at Black River Falls and at the Hayward Nursery are the most advanced generations of jack pine in the program, and are the source of parents for any future breeding work. Timely data collection and proper management of these two plantings will remain a priority. A thinning map will be developed for Black River Falls in early 2017, and a first thinning done later in the year if possible.

The white pine progeny tests at Lake Tomahawk and Black River Falls are the major future sources of white pine seed for the reforestation program. Significant resources were used in 2016 to thin the planting at Lake Tomahawk, and we plan an additional thinning in 2017 to bring the orchard closer to final seed orchard spacing. Without this work, the potential for these trees to be productive orchard trees would be limited.

Bell Center provides the only site for any hardwood seed production in the program. The replacement of the old plastic fence with a taller woven-wire fence added an acre of land to our protected area, in addition to protecting the existing hardwood plantings. Discussions are needed to decide what species would be best suited for planting into the new area. The grafted black walnuts at Bell Center are just reaching sexual maturity, so monitoring for flowering and nut production will be important.

Acknowledgements of Contributions

The cooperation between the Tree Improvement Program and the rest of the State Reforestation Program was outstanding this past year. Joe Vande Hey provided excellent support of program efforts, particularly with the Bell Center fence and Lake Tomahawk white pine thinning projects. Thanks to Roger Bohringer and Jeremiah Auer for making the staff and resources available to accomplish projects that were not possible to complete otherwise. A tip of the blaze-orange cap to Roger for spending a day during gun deer season in a public hunting ground pulling T-posts so the new fence at Bell Center could get built. Special thanks to Michael Ard for his work as the Fecon operator at Lake Tomahawk, for assisting with data collection at Black River Falls, and for his cheerful attitude even when equipment did not cooperate. All of the other staff who worked with Tree Improvement this year were extremely helpful and friendly, and their contributions are much appreciated.



Michael Ard thinning the white pine at Lake Tomahawk – December 2016

Reforestation Monitoring

Introduction

Since 2007, the Division of Forestry's Reforestation staff has examined a sample of Wisconsin's forest plantations during their initial year of establishment to assess the successes and failures of tree planting throughout the state of Wisconsin. A subset of these sites was selected for further monitoring after the 3rd and 7th year of establishment to examine the health and vitality of the seedlings and plantations. The sites included both publicly and privately-owned plantings, large and small acreages, and single species or mixed species plantings. This monitoring also allowed for interactions and discussions with landowners and land managers beyond any conversations at the time of planting.

Personnel

The Regeneration Specialist, Jeremiah Auer, directs the team of limited term employees (LTEs). In 2016, we rehired Michael Ard and recruited a new employee, Katarina (Katy) Walker-Daniels. As in the past, this duo traveled the state, visiting new plantations and establishing regeneration monitoring sites.

Weather Conditions

Planting and growing conditions were uniform statewide in 2016. The lifting conditions were ideal at the nurseries and the subsequent planting season was characterized as seasonal: cooler conditions in the early spring and warm, wet conditions later. The summer provided adequate precipitation throughout the state, coupled with good to excellent growing conditions. Autumn brought adequate precipitation, and warm temperatures that extended into early November. Most of the new seedlings should enter winter in very good condition.

Landowners

As in years past, the majority of seedlings ordered were planted on public property: state forests/lands and county forests. It was slightly more difficult to find private lands that fit our criteria. However, selected private landowners again showed a great zeal for our work and were very willing to discuss and exhibit their plantations.

Site Selection

Sites are selected from among landowners who order a minimum of 3000 seedlings, a volume that can cover approximately 3 acres of land. The landowner's main objective must be to establish a forested environment. Other goals, such as wildlife habitat and erosion mitigation plantings, could be included. However, the management techniques have to focus on developing a forest, and not simply perform a landscaping function.

Assessment Protocol

An analysis of the data collected in 2014 showed that a protocol modification was needed to better answer the question of species survival and plantation progression. Now, in the second year after the changes, staff has become better acquainted with this updated protocol. While a few tweaks may still be required, the structure is sound.

Plot Installation 2016

Following a year of experience using the new protocol, the monitoring staff is more proficient. After a brief training period in which our newest LTE, Katy, was introduced to the protocol from our returning veteran, Michael, staff was able to visit 31 sites representing 27 different ownerships/plantings established in the spring of 2016 (Year "0"). Of these sites, 18 were located on public lands and 13 were on private property. The sites were located in a number of counties (Bayfield-1, Burnett-1, Calumet-1, Clark-1, Columbia-1, Douglas-1, Dodge-1, Door-1, Dunn-1, Eau Claire-1, Forest-1, Grant-1, Iowa-1, Juneau-2, Kewaunee-1, Marathon-1, Marinette-2, Polk-1, Richland-1, Rock-1, Shawano-1, Sheboygan-1, Vernon-1, Vilas-3, Walworth-1, Washington-1, and Waupaca-1) scattered throughout the state. This allowed us to monitor the development of seedlings on a wide variety of soils and communities.



Figure 1: Swamp white oak seedling and whisker marker
Photo by Katy Walker-Daniels, WDNR

After the growing season, staff installed new monitoring sites on plantations in their 3rd growing season (Adams-1, Door-1, Fond du Lac-2, Langlade-1, Lincoln-1, Marinette-2, Marquette-1, Oneida-1, Pierce-1, Rock-1, Sauk-1, Shawano-1, St. Croix-1, Vilas-1, Waupaca-1, Waushara-1, and Wood-2). While we are not able to compare the data from the 1st year to the 3rd year of growth, we will be able to glean at least some information when we revisit in four years.

Staff visited 11 sites that were previously evaluated in 2010 and 2012 and had completed their 7th year of growth (Door-1, Jackson-1, Juneau-1, Kewaunee-1, Manitowoc-1, Marathon-1, Monroe-1, Oconto-1, Portage-1, Richland-1, and Vernon-1). Surviving trees should be well-established and the site captured. The LTEs did not install any post or tree markers on these sites, as we don't plan to return. However, we may reconsider this practice in the future, depending on how the recently established 3-year sites develop during the next four growing seasons.

Data Analysis

Overall, the data collected on the 2,250 newly planted seedlings confirmed anecdotal evidence from statewide observations: Seedlings planted in 2016 did very well. About 92% of all seedlings planted were living or had only minor damage. Approximately 66% of the stems are 1'-3' tall.

The public lands were planted heavily to conifers (83%), with a majority of those (63%) represented by red and jack pines. These seedlings suffered very little browse damage, as is to be expected with newly planted conifers

Private lands were more evenly represented by hardwoods and conifers, with 45% hardwoods and 55% conifers. A wider variety of species was represented as well. Browse was experienced by the majority of oaks in these plantings, demonstrating how oaks are still the most affected species for deer browse

One curious discovery was the planting: Over 45% of all seedlings were planted deeper than recommended (no greater than 2" above the root collar). The vast majority of these were conifers on public lands. This problem was recorded at almost all sites and the planting done by different contractors. It will be interesting to follow these individual seedlings as they develop.



Mixed white pine and oak plantation after 3rd growing season
Photo by M. Ard, WDNR

Overall, seedlings established in 2016 are doing well in the first growing season. However, the current protocol will provide valuable information on how well seedlings respond to perceived deep planting after the 3rd and 7th growing seasons.

It is difficult to compare results from the 3rd and 7th year sites measured under the previous protocol with results from the data collected with the current protocol. However, we can make a few general observations:

- 3rd Year: These sites were scattered throughout Wisconsin. Climatic conditions have been quite favorable since these sites were planted in 2014. Data was collected at 20 sites, representing 20 unique ownerships (11 public land and 9 private land sites). The majority of seedlings observed (1,423) were pine (red pine: 367 seedlings, jack pine: 276 seedlings, and white pine: 182 seedlings).

The vast majority of the seedlings are less than 3' tall (77.4%). Deer browse was typically isolated to the hardwoods. 427 hardwood seedlings were measured, and 259 of them showed at least some browse impact. The oaks were the hardest hit – of the 201 oaks measured, 160 of them exhibited some level of browse. A few sites were fenced, and seedlings found within a fenced area proved to be taller than the average seedlings found outside of a fenced area. Rodent impacts were negligible.

- 7th Year: These sites are scattered in the southern $\frac{3}{4}$ of the state. All had been visited first in 2010 and again after their 3rd growing season in 2012 using the previous protocol. Growing conditions were quite favorable during the past seven years, aside from a few minor dry spells. The seedlings responded accordingly. Almost 60% of the trees are > 5' tall. The taller trees are mostly white and jack pine, but a number of oaks are quite tall as well. The browse pressure is not severe; however, it is present and is undoubtedly limiting many of the oak from reaching their true potential.



Figure 2: Jack pine after 7th growing season
Photo by M. Ard, WDNR

Future Considerations

The new reforestation monitoring protocol seems to work well. We are hoping to create even more efficiency by utilizing newly purchased iPads for data collection and management. This coming year will provide the first opportunity to revisit sites that were originally established in 2015.

Conclusions

The Reforestation Monitoring effort has proven useful and allows the Reforestation program to gather information about seedling performance and plantation establishment statewide, and to stay abreast of any challenges that arise. In addition to providing valuable data on plantation performance, customers and staff are able to interact and exchange ideas and advise on how to best accomplish customer reforestation goals. The 2016 planting and growing season was a success for plantations. However, data analysis in 2017 will begin to show how the plantations are reacting through time and how well the seedlings are able to capture their respective sites.

2016 Nursery Report

The spring seedling distribution season started in November 2015, with the lifting of 379,000 trees and shrubs, mostly at Griffith Nursery. This stock was shipped to Boscobel, where it was graded by an inmate crew at the Wisconsin Secure Program Facility. This work is done as part of a cooperative agreement between the Reforestation Program and Department of Corrections. After grading, the trees were packed for winter storage and placed into the cooler, where they were kept at 26 degrees until spring.

Spring lifting got off to an early start, with digging at Wilson State Nursery in Boscobel beginning on March 16, 2016. By April 7, digging of 2.4 million seedlings was largely finished at Boscobel, nearly 3 weeks ahead of “normal”. Grading operations were finished on April 14.

The Reforestation Program handled the trucking contract for all seedling deliveries again this year. The first truck load of seedlings shipped from Boscobel on March 29. Deliveries to central distributions points in each county (“county trucks” in nursery jargon) began on April 5, with a delivery to 6 southeastern counties. County trucks continued at two or three per week, with the final delivery to northeast Wisconsin on April 28.

The final tally for 2016 was 3,478,000 bare root seedlings distributed by the Reforestation Program. In addition to this, we distributed 1730 stems of large development stock to state owned properties, primarily state parks and trails.

Griffith Nursery still had considerable inventory going into the 2016 distribution season. In addition to the 379,000 fall lifted seedlings, another 782,000 trees were lifted in April of 2016. This left approximately 700,000 seedlings in the Griffith Nursery beds to care for until 2017. In addition to maintaining the remaining seedlings, other 2016 accomplishments were maintaining the half acre prairie drop seed orchard on the nursery, including a spring burn, and harvesting 15 lbs. of drop seed in the fall. Griffith staff was also busy producing over 900 bales of clean straw, plus rye seed, to support nursery operations at Wilson Nursery. Surplus straw and rye was made available for use on other properties.

Hayward Nursery staff continue to be involved in tree seedling distribution, although there is currently no seedling production at the nursery. Orders were again shipped and distributed at the nursery, as well as staff travelling to Wilson and Griffith Nurseries to help with seedling distribution operations in the spring.

Hayward Nursery has about 30 acres of the nursery beds currently in prairie grass production. These fields are being established in partnership with the Wildlife Bureau for seed production on Department lands. They were busy with maintaining various seed orchards and experimental trials, as well as cone buying and seed cleaning. An extensive re-inventory of the seed storage cooler was performed in 2016, along with germination testing of all seed lots in storage.

Hayward Nursery also began an electrical upgrade to the facilities in 2016. This came about as a result of leasing the nursery's large cooler to containerized seedling grower PRT USA Inc., for use in their seedling storage and distribution. A new, independent electric service was needed for the cooler, so the nursery's outdated electric service was examined and scheduled for modernization.

Wilson Nursery, after wrapping up 2016 distribution, turned its attention to growing next year's crop. Germination of the seedbeds planted in October 2015 was somewhat irregular, with several fields germinating slowly, and emerging much later than normal, despite the early spring. This, along with unacceptably high seedling losses due to apparent *Fusarium* outbreaks, led to the decision to establish a side-by-side trial of various soil fumigants for the fall 2016 planting season. In addition to the metam sodium we have used since 2013, white pine, red pine, jack pine, and white oak were planted into replicated plots. These were fumigated with 67% methyl bromide / 33% chloropicrin, 100% chloropicrin, and no fumigation. The plots will be monitored to compare germination rate and timing, seedling vigor, mortality, and weed pressure. DNR Forest Health staff will also monitor soil borne pathogen populations in the trial.

Based on 2016's poor germination and *fusarium* problems, we opted to fumigate four acres of conifer ground with chloropicrin in preparation for fall sowing, while continuing with metam sodium on the 6.5 acres prepped for hardwood and shrub seed beds. 2016 was one of the poorest mast crops in recent memory, with nurseries across the upper Midwest struggling to find acorns. Because of this seed shortage, nearly 1.5 acres of fumigated ground went unplanted at Wilson Nursery, despite increasing beds of hardwoods like cherry, walnut and maple that did have seed available. This region-wide acorn shortage will likely lead to a shortage of local genotype oak seedlings on the market for the spring 2018 planting season, and possibly into 2019.