

# Wisconsin's Reforestation Programs 2017 Annual Report



Jack pine at Greenwood in October 2017 before side-branch removal

**Wisconsin Department of Natural Resources  
State 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 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.

## **2017 Tree Improvement Program Highlights**

2017 started right where 2016 left off, which was the initial thinning of the Lake Tomahawk white pine using a Fecon. This was followed by a second round of tree removal there to achieve a more optimal spacing for use as a seed orchard.

During the winter and early spring months, data on tree height, form, and gall rust scores were analyzed. This resulted in the development of a thinning strategy and map for the Black River Falls jack pine which preserves the most desirable individuals and families.

The biennial Northern Forest Genetics Association meeting was held in May in Rhinelander, Wi., and Ray Guries, Joe Vande Hey, and Stuart Seaborne represented the Wisconsin Reforestation Program. This meeting of tree genetics professionals and seed orchard managers provided an opportunity to present the work they are doing, share information, and to network with one another. Stuart gave a presentation summarizing the recent history and status of the Tree Improvement Program in Wisconsin.

Last year the jack pine and red pine at Ten Mile Creek were hit hard by jack pine budworm (*Choristoneura pinus*). In order to minimize further damage in the orchards, a local contractor was hired to apply an aerial application of the Bt product Foray. Spraying the 23 acres at Ten Mile was completed in June.

The big summer project involved performing extensive maintenance at the white spruce seed orchard in Mead Wildlife Area to prepare for the subsequent cone harvest. Clearing the understory and removing dead side-branches allowed for easier felling of selected trees. The harvest itself was conducted over two days in mid-August. The spruce cones were collected from the tops of the felled trees for seed extraction. This was an important trial-run in creating a viable and cost-effective process for cone collection in the white spruce and other older orchards, and we feel it was very successful.

The older white spruce orchard at Sawyer Creek also received a much-needed mowing during summer of 2017. Staff from Hayward Nursery worked with larger equipment, and Stuart used the new DR Mower and loppers to complete a rough mowing of the orchard.

Fall was largely consumed with maintenance at Ten Mile Creek red pine, Greenwood jack pine, Bell Center hardwoods, and Black River Falls jack pine. The addition of a DR walk-behind brush hog in July was a welcome and necessary complement to the tractor-drawn brush hog already available. The DR mower has enabled much more detailed and less damaging mowing, improving the ability to keep the understory of the plantings under control.

Mild weather in late November allowed us to mark the jack pine to be thinned at Black River Falls using the maps created in the spring. We hope to use a Fecon to rogue out the unwanted trees before spring of 2018.

As we head into the winter months, preparations are underway to work with Scott Rogers, manager of the USFS Oconto River Seed Orchard, to graft butternut scion wood of various origins onto black walnut rootstock. This is part of an effort to identify possible butternut canker resistance in native butternut trees; we are currently discussing the potential for being more involved with this work.

The following discusses these highlights in more detail.

## Mead Wildlife Area White Spruce Cone Harvest

Inventory levels of white spruce (*Picea glauca*) seed for the DNR Nursery program were low, so we had already identified a white spruce cone harvest as a priority for 2017 if possible. Of the three white spruce seed orchards in the Tree Improvement Program, Mead was the only one that had enough trees with plentiful cones to warrant a harvest. Consequently, a substantial effort was made to prepare the area for an efficient cone harvest. That process involved cutting down selected spruce, dropping them between surrounding trees, and using a tractor to pull the trunks out once the tops and the side-branches are removed.

The initial condition of the orchard was that of a thoroughly overgrown understory dominated by large elderberry shrubs (7-feet and taller). Many elderberry shoots originated close to the spruce trunks and were difficult to reach by mower. Additionally, a 'fence' of dead branches surrounded each trunk, making machine access impossible in spots and difficult throughout. It would have made felling and trimming the trees more difficult for the chainsaw operators, and the dead branches presented a safety hazard as well. Therefore, we decided that investing in performing side-branch removal was necessary for adequate access not only to facilitate this year's cone harvest, but to enable future maintenance and cone harvests over the remaining life of the orchard. All of the dead branches were removed up to 9' above ground. The mowing and lopping of the elderberry was completed along with the side-branch removal just in time for the cone harvest.

Trees to be felled for the cone harvest were marked beforehand based on observable cones and tree spacing needs within the orchard. Harvest was done over two days. On the first day, Jeremiah Auer and Todd Pulvermacher dropped the trees and trimmed branches and tops from the trunks, with Kevin Christison pulling out the trimmed logs with a tractor. Michael Ard and Lance Willson assisted each cutter, and Stuart recorded the trees removed on a field map. A total of 21 trees were harvested, and the tops with cones were placed in piles separate from other branches.

On the second day, Stuart and Lance directed a crew of five contract laborers and cut the tops up into more manageable single branches. The workers picked the cones from the branches and put them into feed sacks. A total of **15 bushels of cones were collected, resulting in 14 pounds of cleaned seed**. Quantifying the labor needed and the cost of hiring the cone pickers was critical in determining the viability of this process. Based on the yield, the Reforestation Team feels this is a cost-effective method for future cone harvests.



**Northern Leopard Frogs (*Lithobates pipiens*) were jumping by the thousands this summer at Mead**



**Mowing the elderberry with the tractor at Mead in June 2017**

### **Jack Pine at Black River Falls**

The jack pine (*Pinus banksiana*) at Black River Falls represents a 3<sup>rd</sup> generation progeny test created by crossing trees from the top performing families at Hancock and Ten Mile II. It was planted in 2011 on 4.25 acres of Black River State Forest land in Jackson County. The trees are already starting to form cones, and the site needs an initial thinning to allow for increased cone production and conversion to a seed orchard.

Data collected in 2016 were used in early 2017 to create a strategy and field map for retaining the top performers. By combining criteria for top height and rust scores, about half of the trees of the original number planted were identified for roguing. Actual marking of the trees to be removed happened in late November, and we are working now to arrange for a Fecon to perform the thinning in early 2018.

The jack pine at Black River Falls represent our most advanced breeding efforts with this species, along with another 3<sup>rd</sup> generation progeny test established at Hayward Nursery. These two plantings are expected to replace the ones at Ten Mile II and Greenwood as our chief jack pine seed orchards within the next decade. Anticipating future needs, the Reforestation team has begun discussions to plan for the next generation of jack pine that would succeed Black River Falls and Hayward in a timely fashion. The focus of these conversations is on the direction of future breeding efforts, and what resources would be necessary to create 4<sup>th</sup> generation jack pine plantings.

## **White Pine Thinning at Lake Tomahawk**

Continued from work started in 2016, the initial thinning of the Lake Tomahawk white pine (*Pinus strobus*) was finished in late February 2017, battling cold weather early and Fecon breakdowns throughout. Surveying the results, it was clear that a second round of tree removal would be important to achieve spacing necessary for optimal cone production and tree health.

Based on the same 2011 height data previously used, as well as spacing requirements, Michael Ard and Stuart in February marked another round of trees to rogue with a Fecon. In May of 2017, we were able to finally complete this important and labor-intensive project, which began with the first marking of the trees in the fall of 2015. **A total of 2,651 white pine trees remain from an original planting of 9216 trees (28% of the original progeny test).**

Trees representing 256 families of white pine were planted at Lake Tomahawk in spring of 2002, with a companion subset of 248 families planted in 2003 at Black River Falls. Both originated as seed collected from natural populations in Wisconsin, Minnesota, and the Upper Peninsula of Michigan. As these trees approach sexual maturity, maintaining optimal spacing to facilitate crown development for future cone production will be a priority. There is a plan to assess the planting at Black River Falls in early 2018 for additional thinning of those white pine, and we will continue to monitor Lake Tomahawk as well.



**Michael Ard completes the second round of thinning in the white pine seed orchard at Lake Tomahawk.**

## **Orchard Maintenance**

Mowing, lopping, and removal of dead side-branches are the main activities used to control understory vegetation and allow for easy orchard access by machines and people. The maintenance needed and control methods used depend on several factors, such as age and spacing of orchard trees, and density, size, and species of understory vegetation.

After having borrowed DR Mowers from other DNR programs in 2016, the Tree Improvement program was able to purchase in June a new, better-operating model for program and DNR Nursery use. The DR Mower is a walk-behind brush hog that allows for mowing closer to trunks and in tighter spaces between trees than a tractor-drawn brush hog. They also are far less likely to damage the trunks of the orchard trees while getting close to the trunks. This is especially beneficial for mowing in the jack pine plantings, where live branches block aisles and access to the base of the tree trunks. Both the tractor and the DR Mower will be used as primary tools for understory control to utilize the advantages of each. The addition of the DR Mower will significantly improve the quality of maintenance at all of the Tree Improvement progeny tests and orchards.

Beginning in September 2017, mowing rotated between the hardwoods at Bell Center, the jack pine at Greenwood, the red pine at Ten Mile Creek, and the jack pine at Black River Falls. All except the red pine have a predominantly grassy understory, with brambles and small saplings also present. The red pine at Ten Mile Creek has an understory of mostly oak that had re-grown from mowing two years prior but were already getting thick and tall. After going to each site with the tractor to mow more open areas, the DR followed for use in tighter spots and closer to the trees.

At Greenwood, dead side-branches were lopped off all the jack pine. In the future, mowing there will be faster, better, and more accessible for the equipment. Future cone harvests will also be easier and more efficient.

Ray Aguilera and Stan Klais drove tractor and skid-steer brush-hogs to mow the white spruce orchard at Sawyer Creek in July. The understory had not been mowed in some time, the volunteer saplings were thick and tall, and access was difficult in many spots. The aisle centers were cut, but removal of saplings closer to the trees is needed. One of the impediments towards a doing a more thorough job was the dead side-branches surrounding each trunk, which makes equipment access difficult. Removing these branches will be necessary to facilitate future maintenance and cone harvests.





**Jack pine gall rust (*Endocronartium harknessii*) is prevalent on this jack pine at the Black River Falls progeny test/seed orchard marked for removal**

### **Jack Pine Budworm Control**

DNR Nursery and Forestry Health staff felt that it was important to spray the red pine (*Pinus resinosa*) and jack pine orchards at Ten Mile Creek for control of jack pine budworm following the severe infestation in 2016. Stuart arranged for Reabe Spraying Service in Plainfield, WI. to perform the spraying, acquired the appropriately labelled Foray to be applied, and notified neighbors of what was planned. Mike Hillstrom of Forest Health monitored the site to determine when larval development was at the proper stage for spraying. Foray was applied in early June. While it is difficult to say whether the Bt played a role or not, there was no significant budworm damage at the Ten Mile jack pine site in 2017.

### **Collaboration with Tree Genetics Professionals**

The WDNR Reforestation Team has a history of collaboration and information sharing with other organizations and individuals who work towards advancing tree genetics for productivity and other desired characteristics. The 2017 meeting of the Northern Forest Genetics Association in Rhinelander was an excellent opportunity for the Tree Improvement Program team to share what we are doing in Wisconsin, and to learn what others in the field are studying.

Opportunities for working together have come about as a result of these contacts. One of these is the planned grafting work at Oconto River Seed Orchard. Another involves preliminary discussions with members of the Hardwood Tree Improvement and Regeneration Center (HTIRC) at Purdue and USFS staff about participating in a trial to help determine levels of resistance to butternut canker present in native butternut. This kind of collaboration not only offers potential benefits for enhancing tree research in Wisconsin but enables us to keep current with other efforts to improve forests in our region.

## **Overview of 2018 Tree Improvement Work Plan**

A detailed 2018 Work Plan that outlines specific tasks to be accomplished, and projects where assistance from the Reforestation Program is requested, has been submitted to the WDNR as part of the State Reforestation Program. Below is a summary of the primary Tree Improvement goals for 2018 as noted in that report.

The early months of 2018 include several tasks. Stuart will spend time increasing his grafting skills collaborating with the folks at Oconto River Seed Orchard, primarily working with butternut. There is a plan to do the Fecon thinning at the Black River Falls jack pine at the end of January. A thinning map for the white pine at Black River Falls will be made to create more optimal spacing for the seed orchard there. Further data analysis of the jack pine at Black River Falls will also be completed. When weather and labor availability permit, the lopping of the dead side-branches of the Sawyer Creek white spruce will be completed.

Plans for the butternut planting at Bell Center will be discussed throughout the first part of 2018. Once we decide on a future direction for this species, preparatory work can be started.

During the spring and early summer, regular maintenance (mowing) will occur at Bell Center, Ten Mile Creek, and Greenwood. The old plastic fence surrounding the jack pine at Black River Falls will be removed. Height and gall rust scores will be recorded for the jack pine at Hayward, and the height of the red pine there will also be measured. All orchards will be monitored for cone development in anticipation of future cone harvests.

Later in the summer, if there is significant cone development in a species where seed is needed, a cone harvest will be planned and prepared for. Conifer cone harvests typically occur during the second half of August and the beginning of September. Also scheduled for summer is a regular maintenance mowing in the white pine at Black River Falls.

In the fall, more mowing is planned for the white spruce at Mead, the jack pine at Black River Falls and Greenwood, and the hardwoods at Bell Center. Using updated thinning maps, the white pine at Black River Falls can be marked for tree removal as well.

Late in the year the white spruce will have its overgrown understory mowed with a Fecon or Bobcat brush-hog. It is possible that the white pine will have the actual thinning work done by the end of the year as well, potentially by an outside contractor.

## **Acknowledgements**

I would like to thank the people involved in the Reforestation Program for their cooperation and outstanding contributions, from Reforestation Team managers down to the LTE's. There were many different projects and tasks that required good communication, planning, and execution amongst individual members to be completed successfully. Thinning of the Lake Tomahawk white pine, harvesting the white spruce cones at Mead, mowing the white spruce at Sawyer Creek, and marking the jack pine to be thinned at Black River Falls are all examples where different portions of the Reforestation Team worked together to achieve a successful result. The accomplishments of the Tree Improvement Program would not be possible without this excellent level of teamwork.



**Lance Willson, Katy Walker-Daniels, and Michael Ard helped lop at Mead Wildlife Area to remove the lower dead branches in the white spruce orchard.**

## **Reforestation Program**

### **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 3<sup>rd</sup> and 7<sup>th</sup> 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 allows for interactions and discussions with landowners and land managers beyond any conversations at the time of planting.

#### **Personnel**

The Regeneration Specialist, Jeremiah Auer, directed a team of limited term employees (LTEs). In 2017, we rehired Michael Ard and Katarina (Katy) Walker-Daniels. This seasoned duo traveled the state, visiting new plantations and establishing regeneration monitoring sites. On occasion, they were accompanied by Lance Willson, another Reforestation Program employee working at the Griffith Nursery.

#### **Weather Conditions**

Planting and growing conditions were uniform statewide in 2017, and lifting conditions were ideal at the nurseries. The subsequent planting season was characterized as seasonal: cooler conditions in the early spring and warm, wet conditions later. Summer provided adequate precipitation throughout the state, coupled with good to excellent growing conditions. Adequate precipitation continued through the autumn. 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. However, the majority of orders are for private landowners, planting on private lands.

## Site Selection and Plot Installation

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

After the site is selected, plots are installed randomly within the planted area. Areas greater than 10 acres get 6 plots and sites with 3 – 10 acres get 3 plots.



**Figure 1: White pine within a newly established plantation**

**Photo by: K. Walker-Daniels, DNR**

Marinette-2, Milwaukee-1, Ozaukee-1, Outagamie-1, Sheboygan-1, St. Croix-1, Trempealeau-1, Vilas-2, Walworth-2, Waushara-1, and Wood-2). This allowed us to monitor the development of seedlings on a wide variety of soils and communities.

Each plot center is marked with a wooden stake and orange flagging. The corners are established at 20.87 ft. at a bearing of SW, NW, NE, and SE, and marked using a nail and flagging, the same as plot center. Each seedling within the plot is marked with an identification 'whisker', a small, flexible plastic locator (see Figure 1). The first whisker is blue, followed by pink whiskers to designate the other seedlings. These are mapped to ease data collection in the 3<sup>rd</sup> and 7<sup>th</sup> years.

### Plot Installation 2017

The veteran crew was very proficient. Plots were established on 32 sites representing 26 different ownerships/plantings established in the spring of 2017 (Year "0"). Of these sites, 16 were located on public lands and 16 were on private property. The sites were in several counties scattered throughout the state (Adams – 1, Bayfield-1, Brown-1, Calumet-1, Columbia-2, Dodge-1, Door-1, Grant-2, Jefferson-1, Juneau-2, Kewaunee-2, Lincoln-1, Manitowoc-1,

After the growing season, staff installed new monitoring sites on plantations in their 3<sup>rd</sup> growing season (Adams-2, Burnett-3, Douglas-2, Florence-1, Fond du Lac-1, Jackson-2, Juneau-2, Marinette-1, Monroe-2, Oconto-1, Portage-2, Shawano-1, Sauk-1, Vilas-2 and Waupaca-1). These sites were the first to be installed using the new protocol. Starting this year, we were able to track individual seedlings and determine their progress over the past three growing seasons.

Staff visited 12 sites that were previously evaluated in 2011 and 2013 and had completed their 7<sup>th</sup> year of growth (Adams-1, Door-1, Kewaunee-2, Manitowoc-2, Marinette-3, Shawano-1, Waupaca-1 and Waushara-1). These trees were not evaluated using the current protocol, so it is not possible to directly follow the progress of individual seedlings. However, we were able to make general assessments as to the health and development of the tree seedlings and plantations overall. We did not install any posts or tree markers on these sites, as we don't plan to return. That practice may change for the current 3-year sites depending on their development over the next 4 growing seasons.

## Data Analysis

### Year "0"

Overall: The data collected on the 2,443 newly planted seedlings confirmed anecdotal evidence from statewide observations: seedlings planted in 2017 did very well. Over 89% of all seedlings planted were living or had only minor damage. This is due in part to a very good growing season, flush with precipitation and cooler than normal temperatures throughout Wisconsin. As was the case in 2016, many of the seedlings are planted deeper than is recommended at the nursery. The current protocol counts a seedling as "too deep" when it is planted greater than 2" deeper than the root collar.

Public lands: Historically, most of seedlings planted on public lands are conifers. In 2017, that trend continued as 70% of the stems were white cedar, jack pine, red pine, white pine, white spruce or tamarack, with 71% of these jack and red pines. The conifers were hardly browsed by deer, which is typical in the summer months. Over 43% of hardwoods were browsed, however.

Private lands: Usually private lands host a larger variety but in 2017 private landowners planted a higher percentage of conifers, 79%, than even the public lands. As was the case on the public lands, almost 40% of the hardwoods were browsed

## Year “3”

There are 24 sites in their third year of measurement scattered throughout Wisconsin, representing 21 ownerships (10 privately owned, 14 publicly owned). Climatic conditions have been quite favorable since these sites were planted in 2015, with mild winters and rainy, warm summers. These sites are the first to be resampled after the new protocol was created in 2015. Staff returned to the plot centers and assessed seedlings previously measured in 2015.



**Figure 2: Deer browse on 3-year jack pine plantation**  
Photo by: K. Walker-Daniels, DNR

after one year. After three growing seasons, 26% of the seedlings were impacted by browse, with the number of species affected expanding to include almost all hardwoods and some conifers.

## Year “7”

These 12 sites, representing 11 ownerships (9 privately owned, 3 publicly owned), are scattered in the east central part of the state. All were first assessed in 2011 and again after their 3<sup>rd</sup> growing season in 2013, using the previous protocol. Growing conditions have been quite favorable during the past seven years, aside from a few minor dry spells. The seedlings responded accordingly with 47% of the trees over 5' tall. The tallest trees are jack pine and cottonwood. The average density is 675 trees per acre.

In most cases, locating seedlings was easy because maps and markings for each plot and tree existed. However, twice we were unable to find one of the plots. In another instance, due to a slight change in installation protocol, we did not remeasure 105 seedlings on three plots within the site.

The first-year seedlings had an 89% survival rate. That dropped to almost 73% after 3 growing seasons. Deer browse affected 3% of the seedlings, mostly oak,

After the 7<sup>th</sup> growing season, we no longer revisit the site. Data and experience suggest the trees should be free to grow into mature trees without severe influence from understory competition, browse, and all but the most extreme climatic conditions. Of the 12 sites, it is believed that 7 are free to grow, but 5 of the sites have not been able to overcome severe deer browse, improper planting, or a lack of competition control to fully take advantage of the growing site. It is possible, that with some replanting, proper plantation maintenance, and herbivory mitigation, any or all of these stands could grow to into a mature forest.

### **Future Considerations**

The reforestation monitoring protocol is working well. We continue to adjust techniques and find better tree marking materials, but no major changes are being considered.

### **Conclusions**

Reforestation Monitoring 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 we are able to advise on how to best accomplish customer reforestation goals.

The 2017 planting and growing season was a success for plantations. Continued data collection and analysis will continue to provide the information needed to assist landowners and property managers maintain and manage their forests.

## **Regeneration Trials**

### **Introduction**

In addition to supplying landowners and managers with quality nursery stock, the Reforestation program also endeavors to be a reservoir of information and experience in all things reforestation. Our goal is to create experiments such as testing chemicals used in site preparation, deer browse mitigation methods and equipment, seedling lifting techniques, and storage strategies, to aid in reforestation efforts. In 2017, the Reforestation program conducted two trials.



## Herbicide Trial

The herbicide Transline (active ingredient clopyralid) can be sprayed prior to planting or over existing seedlings. It is meant to control some common plantation weeds such as thistles, knapweeds, horsetail, alfalfa, and clovers. It can also have negative impacts on some tree and shrub species. The current trend in planting is to incorporate a wide variety of species throughout a plantation. This can make utilizing Transline difficult. Reforestation staff wanted to determine if there is a safe spray rate that would impact weeds, but not the trees or shrubs.

Reforestation staff planted 12 blocks of seedlings at the Hayward Nursery. Each block held 10 individuals of 26 species. The seedlings were planted in May, allowed to grow for a month, and then sprayed with varying rates of herbicide. Four groups of three blocks each were either treated with no herbicide (control), 4 oz./acre, 12 oz. acre, or 20 oz./acre. Staff visited the blocks three times to ascertain the health of the seedlings: two weeks prior to spraying, two days after spraying, and 10 days after spraying.

The results are still being analyzed, but anecdotal evidence suggests that there was no noticeable impact on the tree or shrub seedlings from the herbicide. Further analysis will be forthcoming.

## Lifting and Storage

As nursery stock sales decreased, the Reforestation Program consolidated growing operations to one nursery. To alleviate the time constraints that come with lifting, grading, processing and distributing over 3 million seedlings at one facility in less than 4 weeks, staff process a portion of the seedlings during the previous autumn and store the seedlings frozen in our coolers. This is a common practice amongst nurseries; however, there is not much information on how well the seedlings perform in the field after distribution.

The purpose of this study will be to determine survival of various species of bare-root seedlings lifted in the fall of 2016, stored frozen and then out-planted after varying lengths of storage. A second set of seedlings harvested in the spring of 2017 and then planted at similar storage intervals, will act as the control.

Eleven species of seedlings were all planted at the Griffith Nursery: jack pine 1-0, red pine 2-0, white pine 2-0 and 3-0, black spruce 3-0, white spruce 3-0, black cherry 2-0, silver maple 1-0, bur oak 1-0, red oak 1-0, white oak 1-0 and black walnut 1-0. Each

species was represented by 10 individuals within each block. The 18 blocks were randomly assigned.

The first 6 blocks were planted on April 13-14<sup>th</sup> and included seedlings lifted in the fall 2016 and Spring 2017. The next 6 blocks were planted on May 2-3<sup>rd</sup> and included seedlings lifted in the fall of 2016 and spring of 2017. The final 6 blocks of seedlings were planted on May 31<sup>st</sup> and included seedlings lifted in the fall of 2016 and spring of 2017. All seedlings were planted by the same individual, during optimal conditions and with the utmost care.

The seedlings grew and developed, and in late July and early August they were evaluated. The seedlings were noted as being alive and developing, damaged (impacted by some agent, but not enough to cause mortality), faded (impacted by some agent, and not expected to survive), or dead. The results are still being analyzed, but anecdotal evidence suggests that the seedlings lifted in the autumn of 2016 and then planted late were dramatically impacted by these practices, especially the conifers. Seedlings lifted in the spring of 2017 and planted in early spring performed the best. All other groups, seemed to have fared rather well. Further analysis will be forthcoming.

## **Seed Collection**

The spring of 2017 was conducive to seed production and collection. The nursery easily filled its needs for red and silver maple, and river birch. We were even able to put some seed in storage. The following autumn brought an abundance of mast crops, including white, red, swamp white and bur oak, shagbark hickory, hazelnut, and walnut. In addition, we received 11 bushels of butternut from the 2<sup>nd</sup> largest butternut tree in Wisconsin! As always, seed of a few species proved difficult to procure, including black cherry, yellow birch, hemlock, and black spruce. Our current stores enable us to continue to plant these species, but they are dwindling.



**Figure 3: Large clusters of seed on American hazelnut at the Griffith Nursery**  
**Photo by: Jeremiah Auer, DNR**

## Sales

In addition to seed collected and stored for use in producing nursery stock, any seed volumes above our need threshold (7 years for conifers, 3 years for hardwoods), are made available for direct seeding efforts on public or private lands, nursery stock destined for reforestation efforts, or research efforts.

As previously mentioned, the autumn of 2017 was very good for mast crops. For a number of species, however, the seed 'dropped' much later than in other years and caused a slight disruption in some direct seeding orders. Regardless, the reforestation program provided over **400 lbs. of stored seed** (mostly conifer, with a small amount of hardwood) and over **80 bushels of fall produced seed** (acorns, hickory nuts, and black walnuts) to county and state forest managers, university research projects, private and public nursery nurseries, and private landowners.

## **2017 Nursery Report**

### **Lifting, Distribution and Sowing of Tree Seedlings**

The 2017 seedling distribution season started on November 2, 2016 with a limited amount of fall lifting at the Wilson State Nursery in Boscobel. A week later, the entire crew headed to Wisconsin Rapids for a day of lifting conifers, which were brought back to Boscobel for grading and winter storage.

Spring 2017 was unseasonably warm, with mid-February temperatures at Boscobel in the mid-60's. On March 9, 2017, Wilson Nursery hosted the Reforestation Program Team meeting. The nursery was frost-free already, so as part of the meeting, the team put a lifter in the ground and lifted 30,000 shrubs. This was one of the earliest starting dates on record. The cold did return, but by March 20 lifting season was officially underway, and by April 15 all lifting was completed. Superior Forestry Services provided contract labor to assist in lifting and grading seedlings at both Boscobel and Wisconsin Rapids. **The final seedling distribution total for 2017 was 3,079,249 seedlings.** Of that total, 500,000 came from Griffith Nursery in Wisconsin Rapids, liquidating the last of their standing inventory.

Immediately following spring distribution operations, it was time for spring seeding. All seeding took place at Wilson Nursery in Boscobel. 2016 was an incredibly poor mast year, so the nursery went into the spring with a lot of ground prepped for seeding oak that remained fallow for lack of seed. Because of this, and

due to projected inventory shortfalls, extra beds of white spruce, red pine, white pine, and hard maple were sown in the spring. The Reforestation Program keeps cleaned seed of all four species in storage at its Hayward seed extractory, so we are not as dependent on the current year's seed crop as we are with oak and walnut.

In addition to the 'extra' conifer and maple beds, we also sowed our usual spring crops of silver maple, red maple, river birch, and aspen. Due to frequent winter erosion losses in beds of small seeded, shallow sown species, we spring planted white and yellow birch, ninebark, and red osier dogwood on a trial basis to see if spring sowing produces a more consistent crop. Germination was very good, but weed control proved difficult in the spring planted beds. There were also heavy losses on some of the birch and ninebark beds due to what we believe was herbicide damage.

Summer of 2017 was a relatively cool, wet summer. This led to overall excellent growing conditions, but somewhat smaller than normal stock due to the reduced number of hot 'growing' days. Bed densities on most conifer species are below goal once again, but growth rates of the 1-0 conifers sown on Chloropicrin fumigated ground are encouraging. Pine and spruce seedlings appear to be going into their second growing season bigger and in better condition than we have observed in several years.

Fall sowing in 2017 went well. Seeding rates were increased on most conifer species to compensate for the low bed densities due to poor germination in recent years. After consulting with other state nurseries regarding the fickle nature of aspen, birch and other small seeded species, we have followed their advice and purchased germination fabric along with a machine to lay the fabric on the beds. The fabric is a thin, breathable white tarp that protects the bed and is left on until the seedlings are fully germinated. We sowed three rows of birch using fabric this fall, and plan to use this with the birch seed again in the spring, along with aspen seed if we can collect it.

### **Mast Crops**

The acorn crop was again poor in much of the state for 2017, yet the Driftless Area of southwest Wisconsin and northeast Iowa had one of the best mast crops on record. White oak, swamp white oak, and bur oak were abundant and of excellent quality. Red oak seed, which typically comes from collectors in northern and central Wisconsin, appeared to be in short supply again. However, the red oak

trees in the Driftless Area held their seed much longer than the northern trees, dropping three to four weeks later. Once the red oak acorns in the Driftless Area dropped, there was more than enough to fill the nursery's needs.

One interesting side-note of the 2017 acorn season was that collectors reported a much higher than normal percentage of "floaters". These are acorns that looked good inside and out, yet they floated in water. It is likely that dry weather in September dehydrated the nuts. The nurseries only buy acorns that sink when float tested, so pickers had to work hard for what they did sell.

### **Fumigant Use and Trial**

Twelve acres were prepped for fall sowing this year. The nursery returned to the 67% methyl bromide/ 33% chloropicrin fumigant (MBC33) that we had historically used, due to concerns with how the metam sodium fumigant used in recent years has been performing. Root rot issues were historically a problem in the nursery, then seemed to be under control while using MBC33, and now have re-surfaced since switching away from MBC33 in 2012 to metam sodium. Our hope is that the change in fumigant will improve root rot control and lead to increased seedling germination and growth.

The Reforestation Team is undertaking a comprehensive side by side trial of the three fumigants we have recently used, as well as a 'no fumigant' block for comparison, to better document the effectiveness of various soil fumigants. Metam sodium, chloropicrin, and methyl bromide/chloropicrin (MBC33) are the three fumigants being tested. The trial is to test four species' performance under the various fumigants: jack pine, white pine, red pine, and red oak. Due to the poor acorn crop when the plots were established in fall of 2016, white oak was substituted for the red oak.

To date, we have collected weekly inventory and height data on all plots, as well as more extensive height, caliper and dry weight measurements of the jack pine, which will be harvested in spring 2018. The white oak beds germinated very poorly and will be discarded from the trials. We surmise the low germination rates resulted from low seed quality due to the poor mast year, and it was not related to the fumigation methods. White oak seed is also very susceptible to fluctuating winter conditions, and is notorious for rotting in the ground, which is why we would have preferred to test red oak.