

Christmas Tree Promotion Board Supports Research Initiatives

By Jake Sherlock



Detached branch needle retention evaluations conducted in the in the Nisqually Cooperative Fir Germplasm Evaluation project plot

The science behind growing and caring for Christmas trees can have long-ranging impacts on the industry. That's why the Christmas Tree Promotion Board has invested or committed more than \$500,000 in a slate of research projects designed to benefit the entire industry.

"We're all interconnected," explained Della Deal, chairwoman for the CTPB Research Committee. "A research project in Pennsylvania can impact growers in the Pacific Northwest. We try to choose projects all over the country."

The projects that are currently receiving CTPB funding range from having the potential to make a grower's life a little easier to completely transforming a grower's operation.

For instance, several researchers working on a project to grow Trojan and Turkish firs in North America are encouraged by the results they're seeing, and they're just as excited by how big of a hit those species could be with consumers. Other projects focus on controlling pests, like slugs and elongated hemlock scale; how to genetically improve trees; and how drones can be used to save growers time and money.

"Research is the only way you move forward," Deal said. "There's always going to be insect disease issues that is an immediate need to deal with. And then there's genetic improvement, and that's a huge part of becoming profitable and sustainable."

In addition to the \$200,000 allocated in the 2018-19 fiscal year budget, the board recently approved approximately \$177,000 earmarked for future research, Deal said. And all of it will be money well spent to support the industry, she said.

“What’s good for one state is often good for another state,” Deal said. “We’re not competitive with each other, we’re competitive with the artificial tree.”

There are eight projects currently receiving funding.

Turkish and Trojan Firs



The Washington test plot in June 2018.

The Cooperative Fir Germplasm Evaluation project, also known by its shortened moniker CoFirGe or as the Turkish fir project, is an experiment to see how well Turkish and Trojan firs can grow in various locations across the country: Connecticut, Oregon, Washington, Pennsylvania, and Michigan.

What’s the appeal of Turkish and Trojan fir? Project researchers had several answers for this question, but it was Rich Cowles with the Connecticut Agricultural Experiment Station who summed it up best: Consumers will love them.

“The density and foliage and color of the trees is just fantastic,” Cowles said. “They have a dark green, glossy, long needle, and the density of the foliage is exceptional. ... Their growth habits are such that you have lots of branches and lots of foliage.”

In short, they hold many of the same physical characteristics that consumers look for in other firs, said Gary Chastagner, one of the project researchers and Plant Pathologist and Extension Specialist at Washington State University.

“The trend in the tree industry is that true firs have increased tremendously, we’ve seen a big increase in Fraser and Noble firs, those account for at least 70 percent of the U.S. production of Christmas trees,” Chastagner said. “When you look at those species and why there is such a demand for those species, it is largely because of post-harvest quality and stiffness of branches, being able to hold ornaments and having a really nice high-quality foliage.”



Detached branch needle retention evaluations that were done on all of the trees in the Nisqually CoFirGE plot earlier this fall.

That post-harvest quality is especially important to consumers, particularly those who set up a Christmas tree during Thanksgiving week and leave it up through New Year’s and into January.

“Firs have good post-harvest quality,” Chastagner said. “That quality is really important, particularly as the industry faces consumers wanting to buy trees early and have them last a long time, not shedding is extremely important.”

Chal Landgren, a Christmas tree specialist with Oregon State University, said the post-harvest qualities of Turkish and Trojan fir show promise.

“They have great needle retention as long as they’ve had a good couple of freezing episodes before harvest,” Landgren said.

Another upshot of the Turkish and Trojan firs is they stand up well to Phytophthora root rot. Phytophthora root rot exists in wet soils and moves from root to root, “the water mold actually produce spores that swim like sperm, they have tails,” explained Bert Cregg, a research specialist at Michigan State University.

Phytophthora can show up in a variety of soils, which is especially problematic in New England where the soil types changes frequently, Cowles said. “Any field over an acre has more than one soil type,” he said.

For the Connecticut sites, the trees were planted in areas “where you’d never in your right mind plant fir trees,” Cowles said with a laugh. “We found sites that were horrible: wet and heavy soil, water pooling in the bottom of the hole.”

“If anything can survive under those conditions, you have something super special,” Cowles said. The Turkish and Trojans have survived, but they haven’t grown well “with their feet in the water,” Cowles said.

Cowles also explained that one of the sites was chosen for its known high risk of Phytophthora root rot. In the first experiment on that site, every Fraser fir died within three years while Turkish and Nordmann fir suffered only minor loss, he added.

In the Pacific Northwest, Landgren and Chastagner are recording and evaluating how well the trees perform and what types of issues can arise while growing. For instance, Landgren said the Oregon site won’t be ready for harvest for another 4 years because of a gopher problem, while Washington should be ready in two years.

Chastagner said he has been studying needle retention in the trees, noting that the later the tree is harvested the better it retains its needles. In the early branch testing he’s done, Turkish and Trojan fir have shown less needle loss than Fraser fir.

When it comes to pests, deer, rabbits and others have shown a taste for the Turkish and Trojan fir, making deer fence a necessary defense.

“If you don’t have a way to keep deer out, Turkish fir is a non-starter,” Cregg said.

Other issues that Cregg has experienced in Michigan are early bud break and slower growth compared to Washington and Oregon. He said the trees can be slow to establish.

“Northwest trees look great but their climate is much milder than Michigan’s,” he said.

Insect pests haven’t been a major issue for the researchers, but Landgren said it’s still early.

“Most (Turkish and Trojans) are resistant to insect pests. We’re finding that they’re not totally immune to insects, and I’m sure insects will develop a taste for them in time, but right now they’re pretty pest-free,” Landgren said.

Ultimately, are Turkish and Trojan fir viable in the United States? The early evidence may suggest some areas of the country will be better for Turkish or Trojans than others, but there is still much to discover as this project continues.

“We’re learning, and that’s the idea of this project,” Cregg said. “Are these trees going to be suitable for all of these different regions? Those are the kinds of questions we’re looking at.”

Using heat to kill larvae

Chastagner is working on a related project regarding seeds for Turkish and Nordmann fir. This project, just underway, will test whether heat can be an effective treatment against *Megastigmus* larvae, a pest that likes to eat the internal part of conifer seeds.

Nordmann fir is grown widely in Europe, and most seed for Christmas tree production come from native tree stands rather than seed orchards, Chastagner said. The same is true of exotic firs used in the Turkish fir project -- only these come from the Black Sea region, namely Turkey, Russia and Georgia. If the adult wasp can fly to nearby conifers and start laying eggs on the cones of those conifers, the larvae will hatch and seed viability will decrease as a result.

“You can’t manage this pest in the forest,” Chastagner said. “In a seed orchard, you can spray with insecticide when the *Megastigmus* wasp is flying and laying eggs on the cones, which keeps the pest levels down to a lower risk of seed infestation. But when you harvest out of a forest, in some years there is more infestation in seed than in others.”

A high infestation can mean nurseries are unable to collect viable seeds, “so there’s a whole year with no seedlings available, at least from that nursery,” Chastagner said.

If inspectors find that seeds are infested with larvae, all seeds have to be destroyed, Chastagner said, because there is no known treatment for the larvae, only the adult wasps. That’s where his research comes in.

Chastagner is working with nurseries to secure infested seeds to see if he can develop an approach acceptable to the USDA for eradicating the larvae before they eat the internal part of the seed. The first test is to see how well the larvae and seed stand up to heat. Chastagner said he’s hoping the right combination of temperature and exposure time will kill the larvae without damaging the seed.

Leader control for firs

Chal Landgren, the Oregon State University researcher, also has a side project relating to the Turkish and Nordmann fir trees -- he's looking at strategies for controlling the leader.

So far, he's examining three cultural treatments to see which is most effective: Cutting the leader at bud break in April; cutting the leader at 2 inches length, generally in May; or cutting the leader after it is fully elongated, generally in August.

"We're still working up the data on those, but looking at various treatments it seemed like the best time for these two species was in April," Landgren said, adding that preliminary results and final results may change.

He's also experimenting with a growth regulator treatment to see if the leaders on those two species can be limited with the right combination of rate and timing.

"We used a chemical called 'ProTone' plant growth regulator. We found that the right rate at the right time had a pretty success in controlling the leader," Landgren said. He added the same experiment will be repeated by Michigan State researcher Bert Cregg in summer 2019.

"Controlling the leader has typically been done by cutting it in August and maybe a quarter of those we do we have to go back and straighten them up with sticks in kind of a splint," Landgren said. "That treatment on Nordmann and Turkish fir is the most expensive activity ... if we can save growers time from tying up and straightening tops, it will save the most money."

Keeping slugs off of exports

One slug. That's all it takes to shut down a shipment of trees to Hawaii. And fixing the problem can end up costing thousands and thousands of dollars.

Slugs are a very, very important pest to the tree industry," explained Rory McDonnell, Oregon State University's slug expert. "That surprises a lot of people. Many think slugs are pests for field crops ... But in the Pacific Northwest, slugs are the top three most common rejection for exports."

McDonnell offered this example: A shipment of trees grown in Washington or Oregon is bound for Hawaii. Upon port inspection in Hawaii, if so much as one roundback slug is found, the shipment has to either be returned or thoroughly cleaned. Both options are expensive, and in either case the grower pays the price.

That's why McDonnell, along with fellow Oregon State researcher Chal Landgren and Gary Chastagner from Washington State, are developing Integrated Pest Management strategies to keep slugs out of tree plantations as well as shipping yards.

“The fundamental question is: Are slugs getting into trees before they’re cut, after they’re cut, when they’re in the field or when they’re in the shipping yard?” Chastagner said.

To test which slugs are getting on the trees themselves, the researchers use blanket traps that provide the kind of dark and damp refuge slugs look for when day breaks. Some of the blankets are wrapped around the trunk of a tree while others are on the ground. Then, all the researchers have to do is collect the traps once a month and analyze to see which species of slugs are in the area. McDonnell said researchers have collected slugs at seven Oregon tree farms and three in Washington.

The researchers are also collecting slugs at shipping yards, but only during the peak tree shipping times of November and December. Those traps get checked every two weeks.

Once the number of slugs and their species are determined, researchers can then make and test recommendations for managing slugs. That will likely include testing a variety of pesticides, McDonnell said. It might also mean making recommendations for how to maintain shipping yards, since too much surface debris in the shipping yard or around the edges can make for a friendly slug habitat.

Chastagner mentioned two potential treatments for slug-infested trees: Hot water treatments after trees have been bailed or dipping trees in essential oils. Hot water treatments have shown to be effective against slugs without harming trees while essential oils can be effective against slugs but leave trees damaged, Chastagner said.

McDonnell said knowing which species of slug is prevalent at which time and which location is the key to figuring out effective management strategies. After all, he said, some species peak at different times of year, some lay eggs in spring, and some lay eggs in fall.

“Once we have a better idea of the species, we’ll come up with better management strategies,” McDonnell said.

Understanding Elongate Hemlock Scale



Dr. Adam Dale and Paige Patterson, Watauga County extension agent, examine the plants for scale and study them under the microscope to determine if they are alive.

They're tiny, they're armored, they're not native to the North America, and growers can't fully eradicate them, they can only hope to keep the numbers low.

It's not that these bugs, Elongate Hemlock Scale, do great damage to real Christmas trees. It's the unknown of what the scales could do if and when they're introduced to a particular region that moves a state like Florida to stop tree shipments from a state like North Carolina.

Jill Sidebottom with North Carolina State Extension is working to fill in the knowledge gaps about the scales, to help educate well-meaning state authorities on exactly what it is scales will do.

"There hasn't been a lot of research done in this area because they're not that bad of a pest," Sidebottom said.

Sidebottom explained that Elongate Hemlock Scale first showed up in North America more than 100 years ago. Elongated hemlock scale originated in Asia. Pennsylvania was the first state where the scale started impacting Christmas tree growers, in the 1980s. Since then, elongated hemlock scale has moved into 14 different states; as far south as Georgia, as far west as Michigan, and as far north as Maine, Sidebottom said. Elongated hemlock scale has spread much more quickly in recent years, she added.

Scale can travel several different ways -- wind and birds can carry them to other locations. They can also spread through nursery plants and other vegetation, as well as through the export of Christmas trees. And therein lies the problem for growers.

"Fir and hemlock don't suffer much damage," Sidebottom said. "But a study in the 1970s said that scales will kill plants. So even though we don't see that they cause much of a problem, to some states, in their opinion that's just us talking. We had to prove it wasn't a problem."

Sidebottom and her team worked with 17 different tree species, including conifer trees native to Florida, to first infest them with scales and then to track how quickly the scales could reproduce. Her study went on for a year, which allowed for the scales to reproduce through three life cycles.

Because Florida didn't want elongated hemlock scale in the state, even for research purposes, Sidebottom said she and her team members had to conduct the experiment in North Carolina and try to recreate Florida conditions as best they could. The 16 different tree species were kept in a greenhouse that didn't go below 55 degrees Fahrenheit until spring, when they were moved to a shady place in the mountains that is generally favorable for Fraser fir as well as hemlock.



Plants in the greenhouse when they were first infested with EHS. The infested shoots of Fraser fir are attached to each plant.

“One of the issues with the study is that we couldn't create an environment where everyone was happy,” Sidebottom said. But despite those issues, she said the knowledge gained about Elongate Hemlock Scale will be valuable for growers across the nation.

Scales on the trees native to Florida showed little to no reproduction while Fraser and hemlock predictably saw a great deal of reproduction. Sidebottom said she observed males moving to the Florida trees, but the ability for females to develop and produce young was limited.

There are several control methods for elongated hemlock scale, including a parasitic wasp, which is smaller than a gnat, that lays its eggs inside the scale. There are other cultural control options for scales, like reducing the use of nitrogen in fertilizer and not planting new trees near scale-infested trees. And there are several chemical options as well, but Sidebottom said scales can't be completely eradicated from an infested area.

“There is no way to send a 100 percent scale-free plant anywhere,” she said.

Sidebottom listed other areas that may turn down tree shipments because of scale -- namely, southern states that don't have them yet and as well as Caribbean nations that import trees. Sidebottom said she is hopeful that more research about elongated hemlock scale will help the entire Christmas tree industry regardless of whether this scale has reached a particular state or not.

“We've had positive results,” Sidebottom said. “I think we have a very good study.”

Controlling cones in Fraser fir plantations



Cone removal presents significant labor, time, and potential worker safety issues.

Putting workers on ladders 10 feet off the ground to pull hundreds of cones from Fraser fir is time consuming, expensive and raises some major safety issues.

The best way to handle cones can vary from region to region. For instance, Fraser fir grown in Michigan can produce a high number of cones every year – from hundreds up to a 1,000 on larger trees. North Carolina has the same problem, but the severity varies year to year.

Michigan researchers are approaching the problem from two angles; a proactive approach that seeks to stop cones from appearing in the first place, and a reactive approach to control cones after they're growing. North Carolina State University forestry specialist Jeff Owen is focusing on the reactive approach.

“In Michigan they can count on cones every year,” said Jeff Owen, forestry specialist at North Carolina State. “In North Carolina, it’s not as predictable, so the idea of growers needing to treat everything just in case is a little harder sell down here.”

Owen used CTPB research funds for a sprayer that is designed for research rather than production. For instance, the sprayer Owen bought drains better than a commercial sprayer, which is designed to prevent chemicals from one trial mixing with chemicals from the next trial.

“It’s been a bit of a tricky process, but a good sprayer has been instrumental in doing that research,” Owen said.

That research has included testing different herbicides on emerging cones to see which will be the most effective. Bert Cregg, the Michigan State University researcher, said that organic herbicides are primarily fatty acids that, with the right rate and timing, have shown an ability to kill cones without damaging foliage.

In Michigan, Cregg is also looking at soil applied plant growth regulators as another possible solution. The big obstacle here is cost-effectiveness -- because its soil applied, the entire plantation needs to be treated, even the trees that don't have a coning problem. The soil-applied treatment can last for 3-4 years, while applying it to the foliage would need to be done yearly.

With the soil applied plant growth regulators researchers have seen up to a 50 percent decrease in cones. "We're getting the biology figured out," Cregg said. "The next step is to make it cost effective."



Representation of the significant coverage of cones on an untreated tree in the front of the photo, as compared to treated trees behind it.

Drones to control the cones

Researchers at North Carolina State University purchased an unmanned aerial vehicle, otherwise known as a UAV or a drone, through a coordinated research project with the CTPB.

Jeff Owen with North Carolina State said the team hopes to address several problems with the spray drone, including cone and weed control.

"It's absolutely cutting edge," Owen said. "For us to be able to do that in Christmas trees so early in the learning curve for UAV's is tremendously exciting and could have huge potential," Owen said. "So much of Christmas tree country is mountainous. To be able to have a spray

system that is not dependent on roads or slope of land has the potential to become a huge benefit to the industry.”

Drone project team members have taken a flight training course offered by North Carolina State, which inspired several to work on FAA pilot licenses. Essentially, the team is spending the fall and winter months learning everything it can about the drone with the hope of deploying it for research in 2019.

The Future

The Christmas Tree Promotion Board has its eye on the future and believes that the future includes the continuation of these types of projects. The CTPB recently expanded its management team to include Director of Research, Cynthia Alexander. Alexander will work closely with the Research Committee and serve as a contact point for the researchers who are funded by the CTPB.