16th International Christmas Tree Research and Extension Conference held in Denmark

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Image 1 – *Attendees at the 16th International Christmas Tree Research and Extension (CTRE) conference in Kerteminde, Denmark.*

Researchers and extension personnel from North America and Europe met in Kerteminde, Denmark August 11-15, 2024, to discuss the latest in Christmas tree research and extension programming (Image 1). The conference was organized by Drs. Ulrik Braüner Nielsen and Jing Xu at the University of Copenhagen. The conference program featured 33 oral and poster presentations by conference participants as well as field tours to local growers and research sites and a visit to the Langeso fair, the largest Christmas tree trade show in Europe.

Research highlights

This year's CTRE program included 23 oral presentations and 10 poster presentations on topics ranging from marketing to marker-aided selection. Below are highlights of some of the research presentations of interest to growers in the Great Lakes region.

Several presentations at the meeting focused on efforts to accelerate breeding of conifers for Christmas trees.

Jing Xu (University of Copenhagen) reported on the susceptibility of Nordmann fir to silver fir wooly adelgid (SFWA), which is related to balsam wooly adelgid. Xu and her colleagues compared the susceptibility of Nordmann fir from several seed orchards to SFWA and found that the genotypes varied widely in level of damage to the insect. This suggests that selection for resistance is possible. Moreover, they found a high correlation between early screening and later assessments of adelgid damage, indicating that trees can be selected for resistance at a relatively young age.

Ulrik Braüner Nielsen (University of Copenhagen) described the application of genetic markers called SNP's ("Snips" = Single nucleotide polymorphisms) to 'ad hoc' tree breeding (Image 2). To put this development in context, it is important to understand that historically forest tree breeding has largely depended on studying open-pollenated families. That is, we propagate trees produced from cones collected from individual trees and study their performance. Since we know the material parent (the tree we collected the seed from), we can make inferences about which trees in the seed orchard are the best maternal parents. But unless we collect pollen and make controlled crosses (a laborious and time-consuming process), we don't know which trees in a seed orchard are the best 'dads'. Through the analysis of SNP markers, however, geneticists can identify both parents of superior individuals from a population of seed orchard progeny, which can help determine which trees to retain in the orchards. Moreover, the information from the ad hoc breeding approach can help specialists refine estimates of heritability (what proportion of a trait, such as needle retention or insect resistance, is passed to offspring) and breeding values (how much a trait can be improved through selection).

Colin Palmer (British Christmas Tree Association) presented key findings from his research on the ecological aspects of Christmas tree production in the UK. This research has been focused on documenting and understanding the impacts of Christmas tree production including effects on populations of birds, mammals, reptiles and amphibians as well as soil carbon and soil health. In one assessment, the researchers inventoried the occurrence of birds on 7 sites (2 in Northern England and 5 in central England). They recorded the presence of 40 bird species; five of which (greenfinch, linnet, spotted flycatcher, tree pipet, and yellowhammer) are 'red-listed' as endangered species and 8 additional species that are 'yellow-listed' as species of concern. Based on grower surveys, Palmer found that Christmas tree plantations supported an array of animals including mammals, reptiles, amphibians and nocturnal moths (Image 3). However, Christmas tree plantations lagged behind grasslands in soil health, with lower populations of beneficial soil fungi and bacteria. The investigators are studying the effects of cover crops as a means to increase ground cover and soil carbon to overcome these deficiencies.

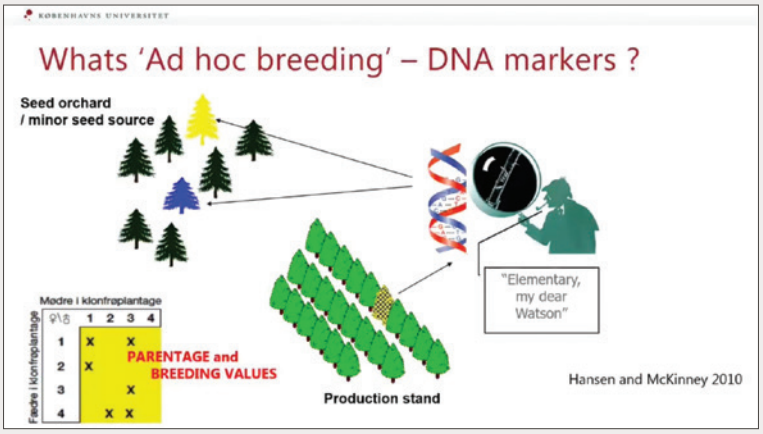

Image 2 – *Advances in the development of DNA markers allow geneticists to identify male and female parents of superior trees. (Image: Ulrik Braüner Nielsen)*

Image 3 – *Research in the UK identified a range of ecological services provided by Christmas tree plantations. (Image: Colin Palmer).*

Kelsey Leonard (University of Waterloo) introduced the Christmas Tree Lab that she has established at the University of Waterloo in southern Ontario. Dr. Leonard presented research that she and her Research Associate, Alison Clarke, have initiated on understanding and mitigating the potential impacts of climate change on Christmas tree production in Ontario. Currently the researchers are conducting surveys of growers within Ontario to determine the current impacts of climate change on Christmas tree farms. Beyond documenting climate change impacts, additional goals of the Christmas Tree Lab at Waterloo are to develop an ecological calendar to

optimize farm activities in relation to changing climate, foster greater collaboration between Christmas tree growers and natural resource agencies, and identify and fill key knowledge gaps (Image 4).

Mason MacDonald (Dalhousie University) reported on research in his lab on understanding the utility of using spectral imaging from unmanned aerial vehicles (UAV's, aka drones) to assess foliar nutrient status of balsam fir Christmas tree plantations. In their project, they developed images of plantations using UAV's equipped with spectral imaging cameras (Image 5). The spectral cameras record light reflectance in individual wavelengths including red and infrared (IR). From the red and IR wavelengths data the researchers calculate the Normalized Difference Vegetation Index. Because chlorophyll absorbs red light more than IR, NDVI is often correlated with leaf chlorophyll content, which, in turn, is related to foliar nutrients. In their trial, MacDonald's lab conducted paired assessments of leaf nutrient concentrations based on standard foliar sampling with NDVI values from the UAV flights in both spring and fall. For both spring and fall assessments NDVI values were significantly correlated with foliar nitrogen (Image 5). Associations between NDVI values and other nutrients (e.g., phosphorus, potassium) depended on the season of sampling.

The results suggest that remote sensing using UAV can provide broad-scale information on nutrient status, especially N, of Christmas tree plantations but further research is needed to refine these relationships (Image 6).

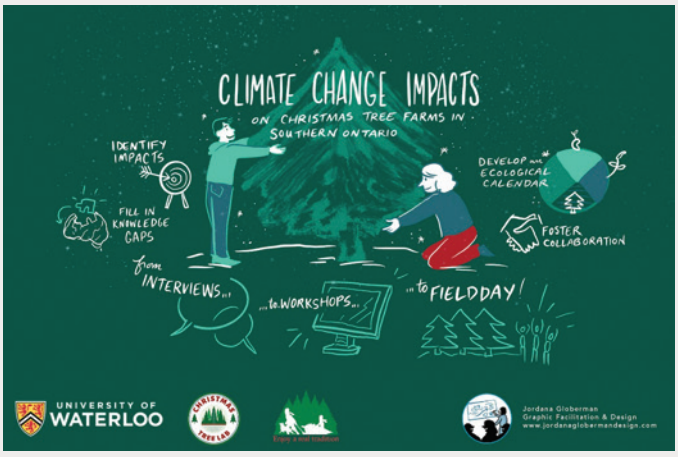

Image 4 – *The Christmas Tree Lab at the University of Waterloo is working with growers to identify and mitigate the impacts of climate change on Christmas tree production (Image: Kelsey Leonard and Alison Clarke).*

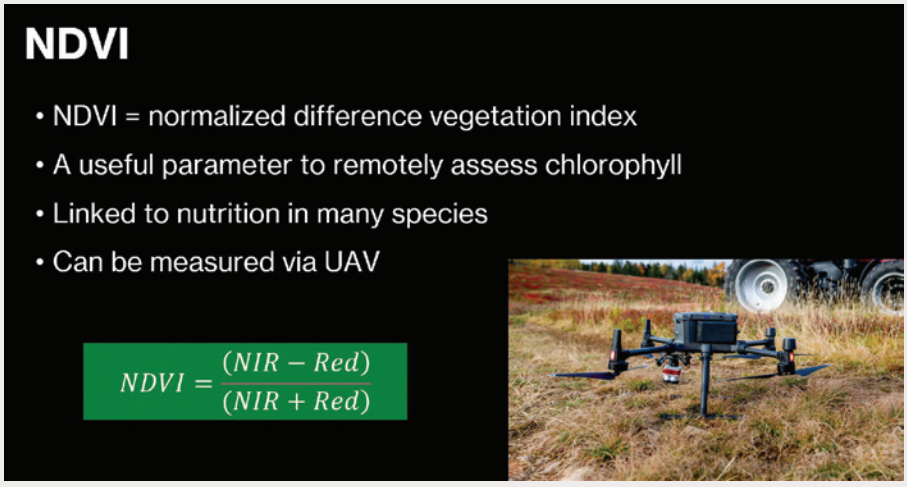

Image 5 – *Remote imagery using UAV's allows researchers to study spectral reflectance patterns in balsam fir plantations. (Image: Mason MacDonald).*

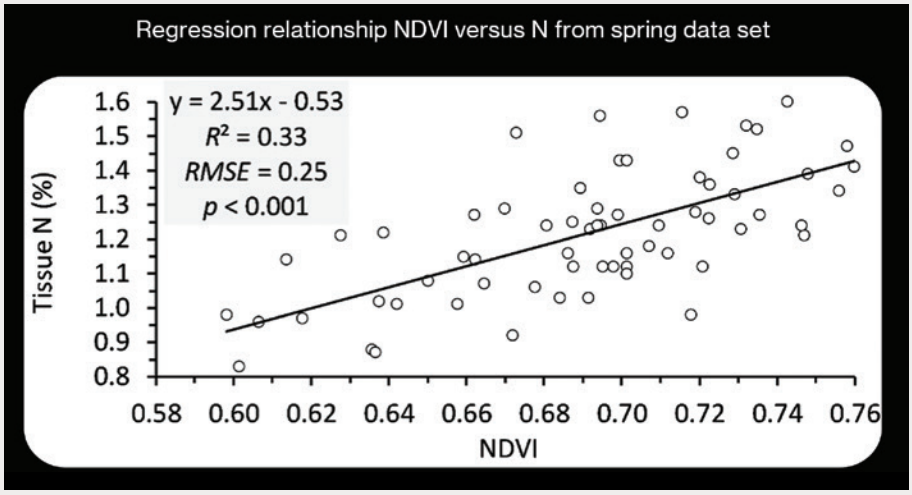

Image 6 – *Understanding the relationship between leaf spectral reflectance (NDVI) and foliar nutrient concentration may allow growers to assess plantation nutrition using drones. (Image: Mason MacDonald).*

Chal Landgren (Oregon State University) provided an update on long-term trends in the Christmas tree industry in the Pacific Northwest. As with other segments of the country, production in Oregon has consolidated, and the number of operations declined from 690 in 2015 to 380 in 2023. Christmas tree harvests in Oregon peaked in 2008 at just over 7 million trees and declined to slightly more than 3 million trees in 2023. Tree planting in Oregon has remained stable over recent years. Oregon growers are increasingly planting Nordmann and Turkish fir (310,000 trees in 2016 to 1.2 million in 2024). Pacific Northwest growers are also facing increasing issues with seedling mortality due to increasingly variable weather patterns. Based on Oregon State's survey, seedling mortality increased from 12% in 2020 to 25% in 2023, with 1.4 million trees lost in 2023.

CTRE meeting tours

The tours associated with the CTRE meeting highlight some of the differences in Christmas tree production in Denmark and Europe versus North America. Nordmann fir is by far the most widely produced species in Europe and is the main species grown by Danish growers. Denmark produces about 11 million trees annually. However, around 90% of these trees are exported. In contrast to the U.S. where many consumers purchase their tree in late November, Europeans typically select their tree just before Christmas and display it until Jan. 6, the Feast of the Epiphany. On the tour, the Danish host noted that tree preferences vary throughout Europe and that growers must adapt their cultural practices to their intended market. The grower noted that French customers typically prefer a fuller, denser tree; whereas consumers in Germany prefer trees with a more open, layered form (Image 7). European growers place a premium on preserving a whorl of terminal buds in order to maintain tree symmetry. To prevent excessive leader growth, the grower we visited relies on a combination of mechanical leader control with the top-stop nipper and chemical growth control using Con-shade (S-ABA) (Image 8).

Image 7 – *A Danish Christmas tree producer explains the challenges of culturing trees for different market preferences throughout Europe.*

Image 8 – *Some Danish growers use the Top-stop nipper, alone or in combination with plant growth regulators, to control tree growth.*

The CTRE tour included a stop at a clonal seed orchard that researchers from the University of Copenhagen are using to understand the relationship between silver fir gall adelgid and neonectria canker. Research at the site demonstrated the linkage between adelgid and subsequent infections by neonectria canker (Image 9).

In addition to producing Nordmann fir for Christmas trees, Denmark is a major producer of boughs for florist greenery and wreaths. Danish producers grow noble fir, which is native to the Pacific Northwest, for boughs. They maintain plantations that are harvested periodically for high-quality bough material (Image 10).

Image 9 – *Dr. Jing Xu (center) explains research on the interaction of silver fir adelgid and neonectria canker in Nordmann fir.*

The tour also included stops at Levinsen seed company (Image 11), one of the largest conifer seed dealers in Europe, and the Langesø Christmas tree fair.

The Langesø fair is the largest Christmas tree trade show in Europe and featured a wide array of vendors. A consistent theme of products on display at the show reflect an emphasis on eco-friendly products (Images 12 & 13) and well as mechanization for the tight labor market in Europe (Images 14 & 15).

Image 10 – *Denmark is a major producer of noble fir boughs for Europe. (Image: Mason MacDonald).*

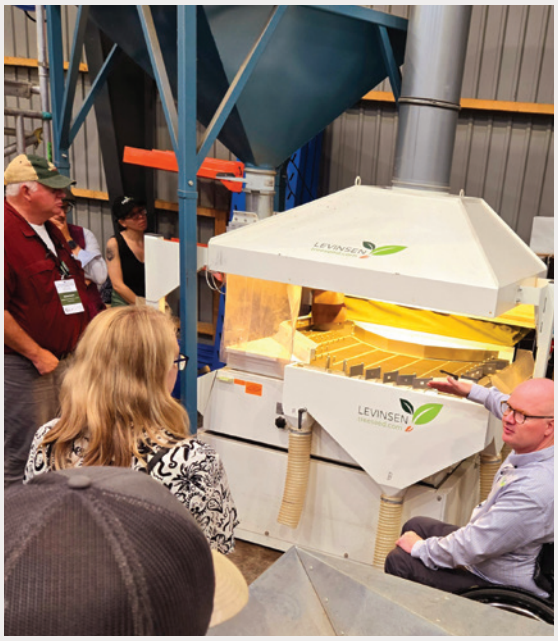

Image 11 – *Seed processing equipment at Levinsen seed A/S.*

Image 12 – *"A heart for nature". European growers market the environmental benefits of Christmas trees.*

The proceedings of the 2024 CTRE and videos of selected presentations are available at the Christmas Tree Working Group page of the International Union of Forestry Research Organizations (search 'IUFRO Christmas trees' in your browser). The 17th CTRE will be hosted by North Carolina State University in 2026.

Image 13 – *Organically produced fir transplants.*

Image 14 – *Power-assist hand-pruners for top-work or basal-pruning.*

Image 15 – *Mechanical tree-cutters.*