Regional variation in postharvest needle loss from trees in CoFirGE planting sites

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Introduction

There has been increasing interest in growing exotic species, such as Turkish, Trojan, and Nordmann firs as Christmas trees in the United States. These species are resistant to a number of diseases and insect pests, such as Phytophthora root rot and balsam wooly adelgid that can kill or seriously damage many commonly-grown North American species of firs, such as noble and Fraser fir. The increased use of these exotics is limited by the availability of proven high quality seed sources, questions about their regional adaptability, and concerns about their postharvest needle retention.

In 2013, a series of 10 regional common garden plots were established as part of the Collaborative Fir Germplasm Evaluation (CoFirGE) Project to identify regionally adapted sources of Turkish and Trojan fir that have the potential to produce superior Christmas trees in five production regions of the United States and in Denmark. Each planting contains approximately 3,500 trees. They include progeny from 55 families of Turkish fir (3 provenances) and 34 families of Trojan fir (2 provenances) from Turkey, and seedlings from proven Christmas tree sources of balsam, Fraser, grand, Korean, noble, and Nordmann (3 provenances and 2 Danish seed orchards).

Needle retention is an important attribute of high-quality Christmas trees. A detached branch test has been used to obtain information on the variation in needle retention of all the trees in the WA Nisqually CoFirGE plot since 2017. The regional CoFirGE test plantings provide a unique opportunity to determine if sources of trees that exhibit superior needle retention characteristics in one region exhibit similar patterns in other regions.

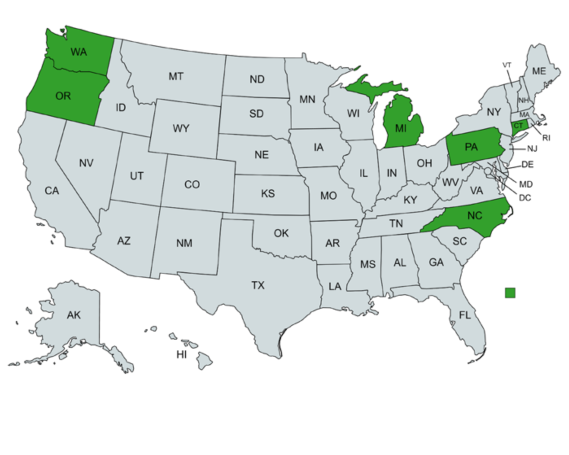
Objective

Compare the regional variation in needle loss (NL) patterns of 13 sources of trees in the CoFirGE plots in Connecticut (CT), Michigan (MI), North Carolina (NC), Oregon (OR), Pennsylvania (PA), and Washington (WA).

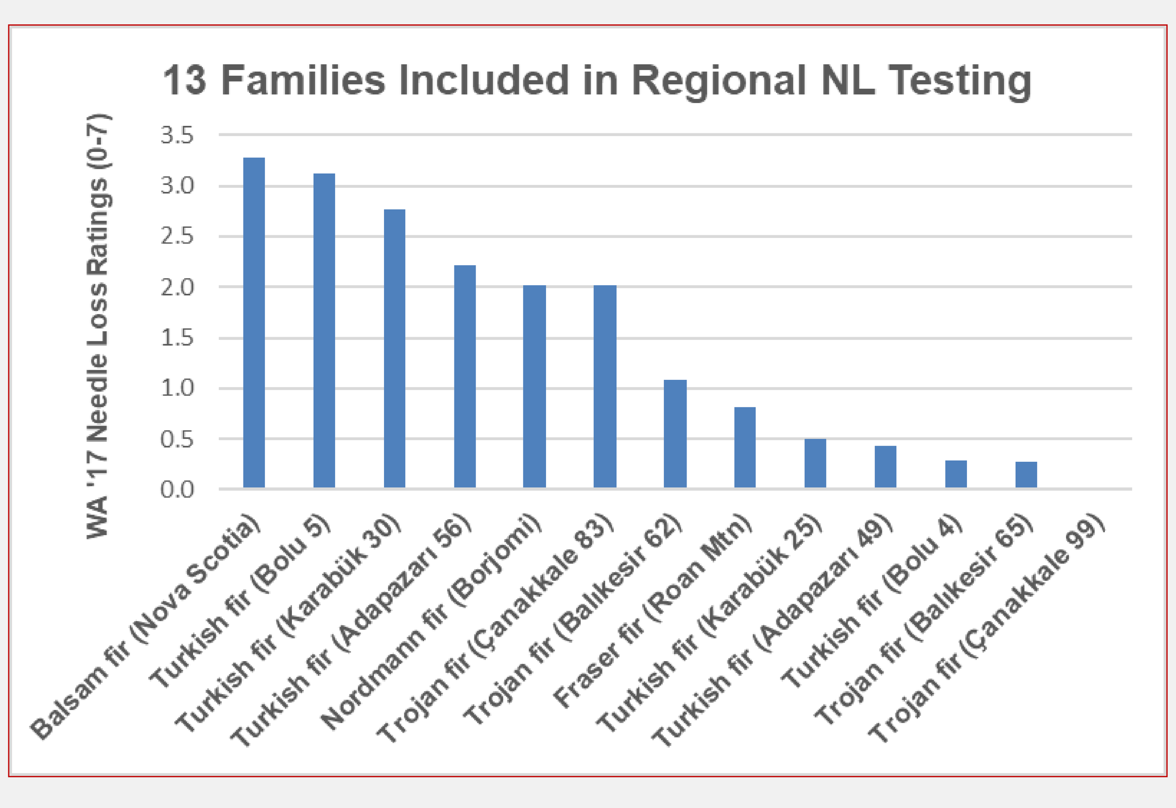
Materials and Methods

In collaboration with the following CoFirGE project participants, NL testing was done in 2019 and 2020 on 2-year-old branches from all the trees in 6 Turkish fir and 4 Trojan fir families, along with one source each of Nordmann, balsam and Fraser fir growing in regional CoFirGE plots in 5 states.

- CT - Rich Cowles, Connecticut Agricultural Experiment Station
- MI - Bert Cregg, Michigan State University
- NC - John Frampton, Justin Whitehill, and AnnMargaret Brahm, North Carolina State University
- OR - Chal Landgren and Judy Kowalski, Oregon State University
- PA - Rick Bates, Pennsylvania State University

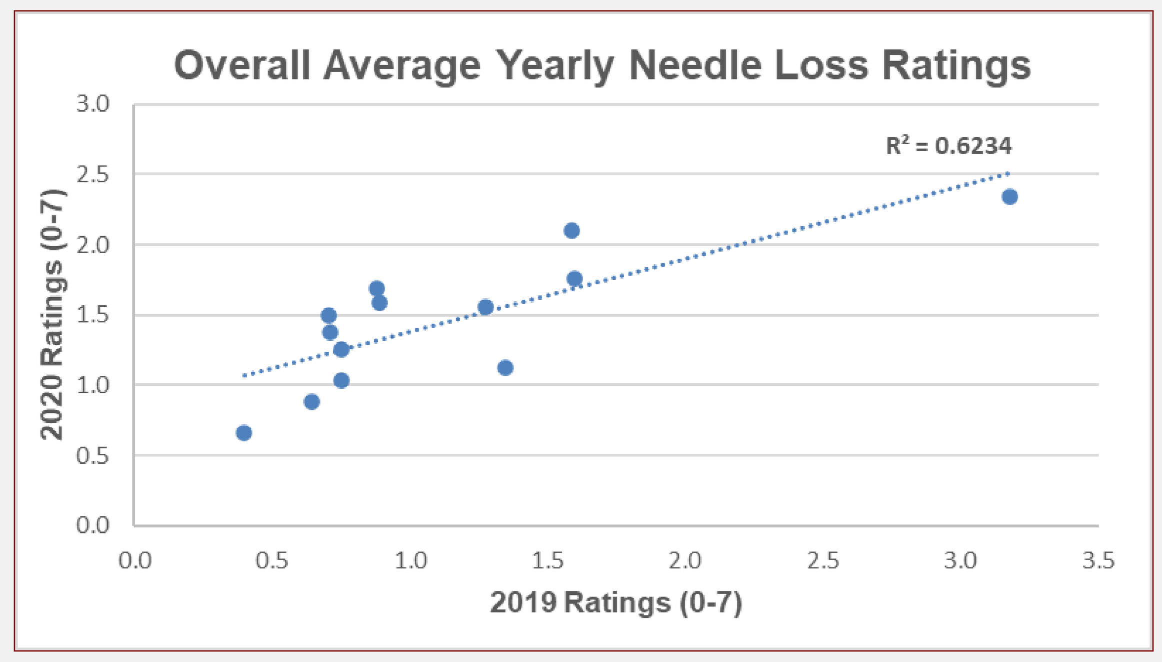


These sources were selected because they exhibited a wide range of NL in preliminary 2017 tests of trees in the CoFirGE Nisqually plot in WA. Branches were shipped overnight to WSU Puyallup for early-season NL testing in mid-October in 2019 and 2020. Upon arrival at WSU Puyallup, the branches were displayed dry in a lighted (24 hrs) display room at 20C, and the loss of 1 and 2-yr-old needles on each branch was rated on a scale of 0 to 7 (0 = none, 1=< 1%, 2=1-5%, 3=6-15%, 4=16-33%, 5=34-66%, 6=67-90%, 7=91-100% NL) over a 10 to 13-day period. The presence of frost damage on the samples was also noted.

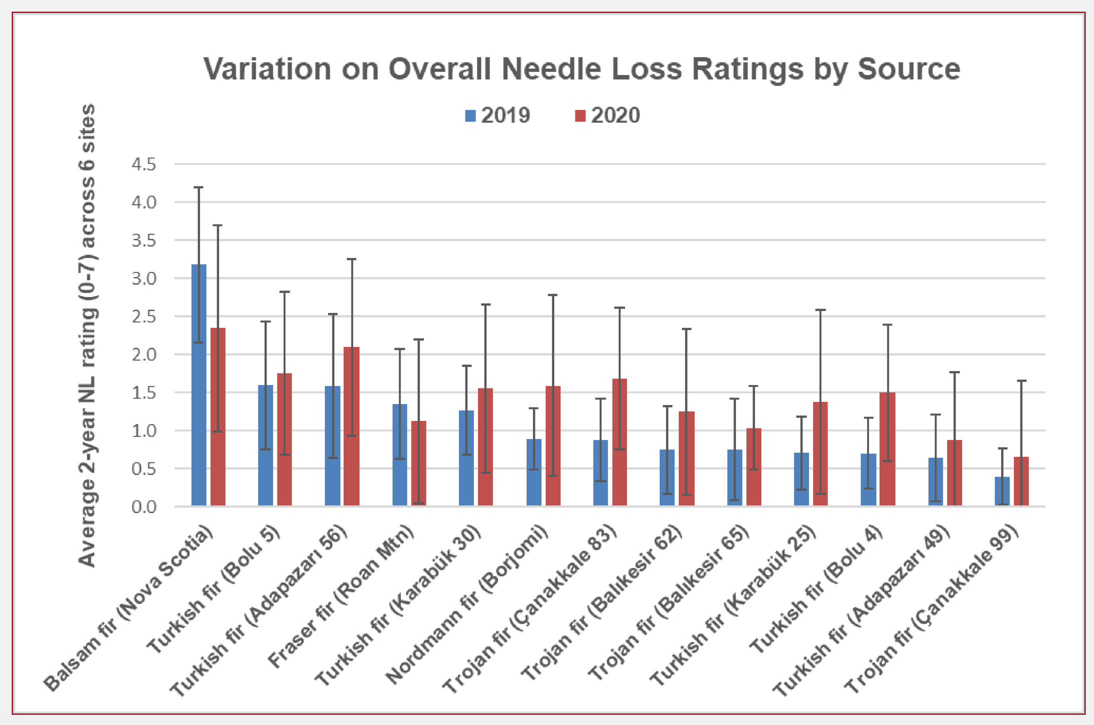


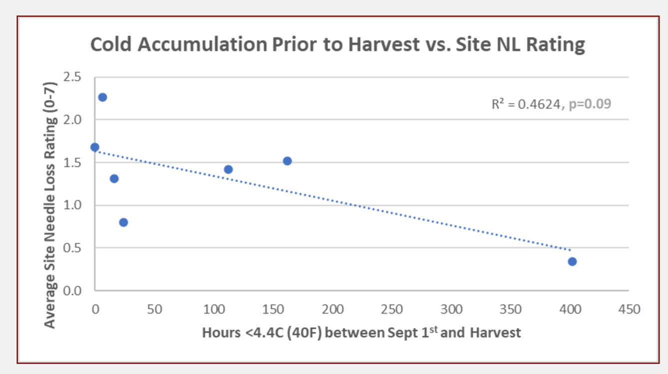
Results

Across all sites, overall NL ratings for the 13 sources of trees averaged 1.1 (0.4 to 3.2) in 2019 and 1.5 (0.7 to 2.3) in 2020 and there was a highly significant correlation between the 2019 and 2020 ratings.



Balsam fir consistently had the highest NL rating and several of the Turkish and Trojan fir families had the lowest ratings across all 6 sites. Although temperature data prior to harvest was not available for all harvests, the data from 9 harvests suggest that cold accumulation prior to harvest likely influences the variability of NL ratings among the sites and years. As indicated by a rank mean correlation analysis of the 2019 data, there was generally a significant correlation between the NL rankings from site to site.





2019 Needle Loss Rank Mean Correlation Coefficient

Sites	CT	NC	PA	OR
WA	0.6819***	0.5589**	0.1972	0.6237***
CT		0.4946**	0.3141*	0.5992***
NC			0.3787*	0.6237***
PA				0.2245

* p<0.05, **p<0.01, and ***p<0.001

Summary

Needle loss patterns were generally similar across the six sites where samples were collected. Although the severity of NL varied from site-to-site, the NL patterns of individual sources were consistent from region to region. Sources of trees with the highest and lowest NL ratings were similar from site-to-site and year-to-year. This indicates that NL testing done in one area can potentially be used to identify sources of trees that exhibit excellent needle retention over widely different production regions.

Selected References

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