2024 Swiss Needle Cast Cooperative / Washington Needlecast Working Group Annual Tour

Southwest Washington / Northwest Oregon

May 30th, 2024

8am-3pm

8am: Meet at the east end of the Bolstad Pavillion parking lot
420 Bolstad Ave West, Long Beach, WA 98631 (beach access parking lot)

I. Stop 1: Quinault SNC Douglas-fir Progeny Trial

   a. Introductions

   b. Swiss needle cast overview

   c. SNC Aerial detection surveys

   d. Progeny trial design, results and discussion

II. Stop 2: Swiss Needle Cast Cooperative Research and Monitoring Plot

   a. SNCC plot network design and research summary

   b. Observe and discuss pseudothecial occlusion and foliage retention

   c. Plot-level estimates of Douglas-fir growth in the absence of SNC

III. Lunch ~12:30pm

Bring your own lunch. Snacks and beverages will be provided.

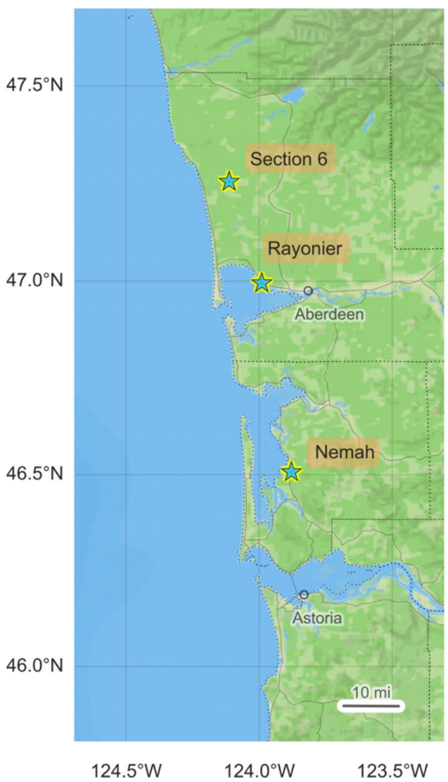
IV. <u>Stop 4: Western Hemlock Realized Gain Trial</u>

a. Project background, study deign, and results

3pm: Concluding remarks

Quinault SNC Douglas-fir Progeny Trial

This progeny trial, established in the heavily affected Swiss Needle Cast (SNC) zone near the coast, was a collaborative effort between the Quinault Indian Nation and the Washington Coast co-op. The trial aimed to (1) evaluate Douglas-fir full-sib families for SNC tolerance to inform seed deployment strategies, and (2) compare the results of this trial with existing second-cycle Douglas-fir progeny trials.



A total of 50 full-sib families (or crosses) were selected from various sources in Washington and Oregon, involving 77 parent trees. Two Douglas-fir woodsrun checklots and one western hemlock seed orchard control lot were included for comparison.

Seeds were sown in 2014 and planted on three sites in 2015. Each site, located in a somewhat sheltered area to minimize salt spray exposure, spanned 2.7 to 3.2 acres and was fenced with an 8-foot fence. A single-tree plot design was implemented at each site, with 50 families and three control lots randomly distributed. Trees were spaced 9 feet apart in a hexagonal pattern.

Seven years after sowing, the following traits were measured: total height (*ht_7*, cm), diameter at breast height (*dbh_7*, mm), number of forks (*fork_7*), number of ramicorns (*rami_7*), stem sinuosity score (*sinu_7*), and second flush (*flush_7*, yes/no). Additionally, two foliage health traits were assessed to quantify SNC severity: (1) Needle retention (*ret_7*): Years of needle retention were measured on three separate secondary lateral branches on the fourth whorl down from the top. Scores ranged from 0 to 3, with an average calculated for each tree. (2) Spore count (*spor_7*): Pseudothecia counts on needles were categorized as 1 (light), 2 (moderate), or 3 (heavy).

Approximately 3,700 trees were measured for *ht_7* and *dbh_7*, while 3,620 trees were assessed for the remaining traits.

At age 7 (or 6 years after planting), the family mean *ret_7* ranged from 1.68 to 2.25 across the three sites. Similarly, family mean *spor_7* ranged from 1.61 to 2.36.

The average *ht_7* and *dbh_7* for the test families were 427.8 cm and 49.6 mm, respectively. As anticipated, the two Douglas-fir woodsrun checklots exhibited slower growth compared to the breeding population, with average *ht_7* and *dbh_7* measurements of 390.3 cm and 43.4 mm, respectively. The western hemlock seed orchard checklot displayed faster height growth (468.6 cm) but slower diameter growth (46.3 mm) compared to the average Douglas-fir families.

Genetic analysis revealed narrow-sense individual-tree heritability estimates of 0.25 to 0.26 for growth traits, 0.22 for *ret_7*, and 0.07 for *spor_7*. For other traits, heritability estimates ranged from 0.01 for *fork_7* to 0.44 for *flush_7*. Family-mean heritability estimates were ⩾ 0.8 for growth, *ret_7*, and *flush_7*, ⩾ 0.6 for *rami_7*, *sinu_7*, and *spor_7*, and approximately 0.2 for *fork_7*. The relative importance of specific combining ability (SCA) effect in the across-site analyses was minimal (0% to 5%) for growth and 0% for both SNC traits. This indicates that SCA effect is less significant than general combining ability (GCA) effect for these traits, suggesting that tree breeders can effectively utilize additive genetic variation.

Summary report on DNR52

Measured data at the time of establishment (t=plantation age 13 yrs.) and 5 (t+5) and 10 years later (t+10) were compiled within CIPSANON, based on 40 foot logs (16 ft minimum length, 4" min. top diameter)

Measured data

Age (plantation, yrs)	TPA	BA (ft2/ac)	QMD (inches)	Ht40 (ft)	Vol (ft3/ac)	Scribner vol/ac
13	545	43.3	3.8	28.5	328	0
18	540	108.9	6.1	44.6	1461	1800
23	505	154.9	7.5	57.3	2655	5350

Foliage retention has changed significantly at this plot over the 10 year life of the study (fig. 1). The long measurement periods makes it difficult to know how foliage retention varied between measurements, so a linear interpolation was used as one option (fig. 1).

The initial treelist was projected within CIPSANON using a 50-yr foliage retention-adjusted SI of 126.8 ft. Projection estimates apply site-specific climate and soil variables based on the plot latitude/longitude.

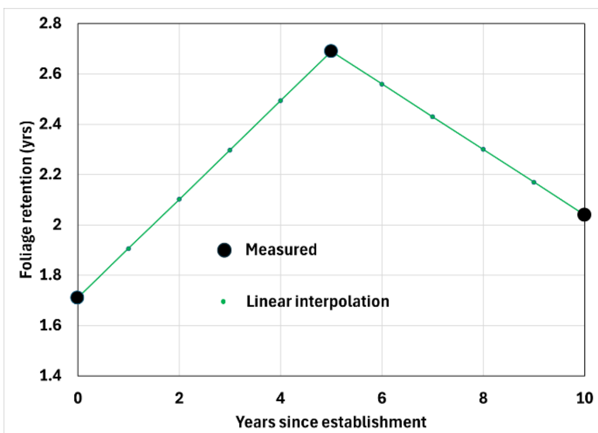


Figure 1 Foliage retention, measured at year 0, 5, and 10, and linearly interpolated values used in CIPSANON projection.

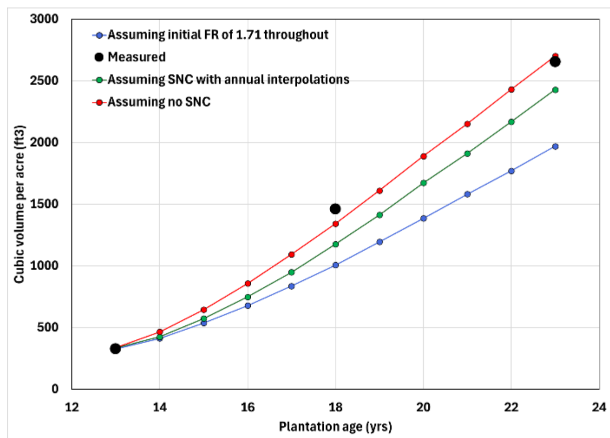


Figure 2 Measured and simulated cubic-foot volume per acre, assuming three different foliage retentions.

Results from the projection indicate that the plot is performing better than expected, even after accounting for site-specific adjustments (fig. 2). Without site-specific adjustments, SNC-free volume at year 10 is estimated to be ~4.9% lower than is shown by the red line in figure 2.

The model is underpredicting growth at this site. Comparison of the healthy output (red line) to the interpolated foliage retention output (green line) for this site provides a best-guess estimate of cubic volume growth loss to be ~10%.

Swiss needle cast research plot network: second remeasurement of group 1 plots

Doug Mainwaring, Gabriela Ritóková, Dave Shaw, and Adam Carson

Abstract

The second five-year remeasurement of the first third of the SNCC research plot network (RPN) has been completed (30 plots). The negative effect of SNC on cubic volume growth during the second 5-year period was compared to that on the same plots during the first five-year period. The negative effect of SNC due to diminished foliage retention was found to be ~23% greater during the second period for the lowest estimated initial foliage retention (1.2 years). The greater estimated negative effect of foliage retention during period two is similar to that estimated for the 1998-2008 GIS plots. Some of this difference may be due to positive changes in foliage retention between period 1 and period 2. The potential for changes in foliage retention during the five-year growth periods of the current plot network have the potential of affecting estimated growth losses, and should be accounted for in future analyses.

Introduction

The RPN was initiated in 2013 to address two major objectives: 1) to monitor Swiss needle cast (SNC) symptoms and tree growth in 10-25-yr-old Douglas-fir plantations throughout the Oregon Coast Range and southwest Washington; and 2) to provide an improved estimate of growth losses associated with a given initial level of SNC. Volume growth losses were estimated to average 23% for the target population in 1996, with losses reaching 50% in the most severely impacted stands. Four subsequent remeasurements through 2008 confirmed these estimates (Maguire et al. 2011). In contrast, during the five-year period of the RPN's first measurement period, estimated cubic volume growth losses were a maximum of ~35% at a foliage retention of 1.0 years.
The objectives of this report are: 1) to quantify the most recent 5-yr growth responses relative to initial SNC severity; and 2) to compare this 5-yr growth responses to those estimated for the same plots from 2013-2018.

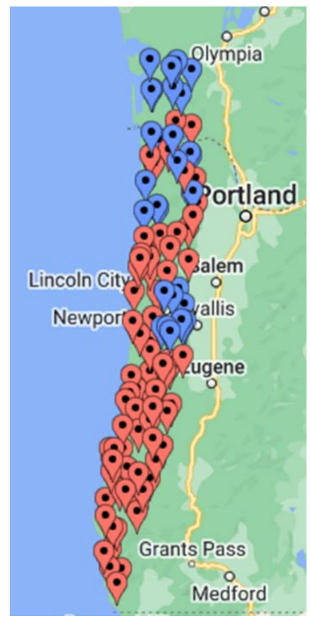


Figure 1 Location of the SNCC RPN; Blue symbols show location of the group 1 plots analyzed in this report.

Methods

Study sites

Establishment of the RPN began in the Fall of 2013, and ultimately included 106 plots installed over three years. These plots were established in 10-25 year old Douglas-fir plantations (>80% BA in Douglas-fir) that had not been treated in the last five years, and were distributed from the Oregon-California border to SW Washington, and from the coastline to 35 miles inland

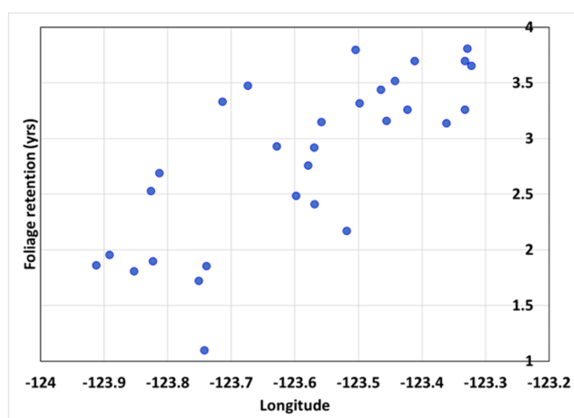
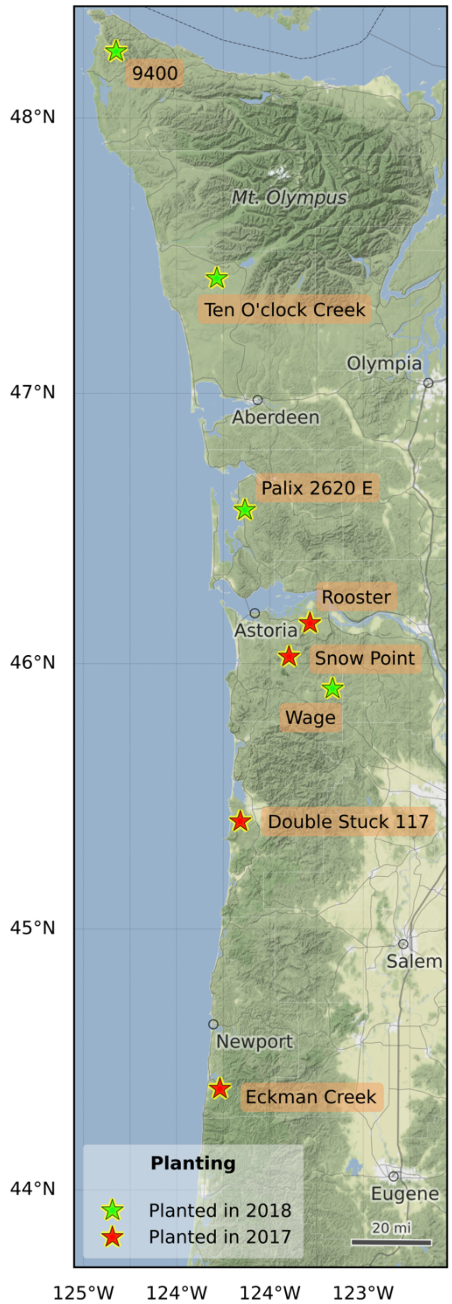


Figure 2 Distribution of foliage retention by longitude.

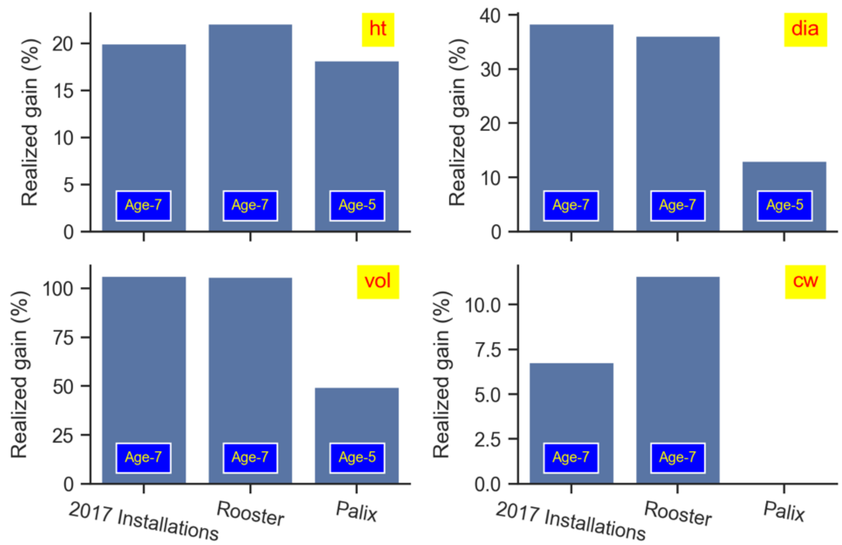
Western Hemlock Realized Gain Trial

The western hemlock realized gain trial is a collaborative project between the NW Tree Improvement Cooperative (NWTIC) at Oregon State University and the Stand Management Cooperative (SMC) at the University of Washington. A genetically improved elite seedlot, with nine top-performing second-cycle full-sib families, was planted alongside an unimproved woodsrun seedlot at eight sites on the western Washington and Oregon coast in 2017 and 2018.



Each site was established with a regular grid spacing of 10 feet, and approximately 121 measurement trees per plot at planting. Trees planted in 2017 were assessed in 2023 at 7 years old (6 years from planting), and those planted in 2018 were measured in 2022 at 5 years old. The following traits were measured: total height (*ht*, cm), diameter at breast height for 7-year-old trees or basal diameter for 5-year-old trees (*dia*, mm), and crown width (*cw*, cm). In addition, a volume index was calculated using the formula: $vol = ht \times dia^2 / 10{,}000$.

Realized gain was calculated as $RG\ (\%) = [(Xe - Xu) / Xu] \times 100$, where Xe and Xu are the predicted means of the elite and the unimproved seedlots, respectively.



At age 7, the elite seedlot exhibited significantly faster growth than the woodsrun seedlot across the four sites planted in 2017. The elite seedlot achieved 20% gain in height, 38% gain in diameter, 106% gain in volume index, and 6.8% gain in crown width over the woodsrun seedlot.

While the % realized height, diameter and volume gain at the Rooster site was close to the average across all sites, it had above-average realized gain in crown width. The realized gains at the Palix site were comparatively lower at age 5. The elite seedlot averaged 524 cm (17.5 feet) in height at 6 years from planting at Rooster with the tallest trees approaching 792 cm (26 feet).

Significant, but non-crossover, interactions were observed between site and seedlot effects. The elite seedlot consistently outperformed the woodsrun seedlot at every site.

(Ritóková et al. 2017). These plots and their measurement protocols are identical to the original Growth Impact Plots (Maguire et al. 2011).

In the spring following establishment, and again following the second remeasurement, foliage retention (nearest 0.1 year) was estimated from laterals within the middle crown third of five dominant trees on the plot. In young stands with highly visible crowns, this could usually be done visually from the ground; for older stands, estimation required climbing. Data summaries of the plot network can be found in a previous SNC annual report (Ritóková et al. 2017).

The second remeasurement of the first thirty plots of the network took place in the fall of 2023 (fig. 1). These plots were generally in the northern half of the network, and tended to have a greater proportion of plots with lower levels of SNC than subsequent remeasurement groups (fig. 2).

Statistical analysis

The equation for estimating the stand level cubic volume for the entire plot network was:

$$[1] \quad CFV\_PAI=a_1 \cdot (BA_{df}^{a2}) \cdot \exp(a_3 \cdot BA_{ndf}) \cdot SI_{adj}^{a4} \cdot (1-\exp(a_5+a_6 \cdot FR^3))$$

With CFV_PAI being the five-year periodic annual cubic volume increment (volumes estimated using CIPSANON), BA_{df} was stand level Douglas-fir basal area, BA_{ndf} was stand level basal area of all other species, SI_{adj} was site index adjusted for foliage retention (Mainwaring et al. 2020), and FR was initial foliage retention at the start of the period. For the smaller 30 plot subset, a_3 and a_4 were insignificant predictors, resulting in the reduced equation [2], fit separately to each period:

$$[2] \quad CFV\_PAI=a_1 \cdot (BA_{df}^{a2}) \cdot (1-\exp(a_5+a_6 \cdot FR^3))$$

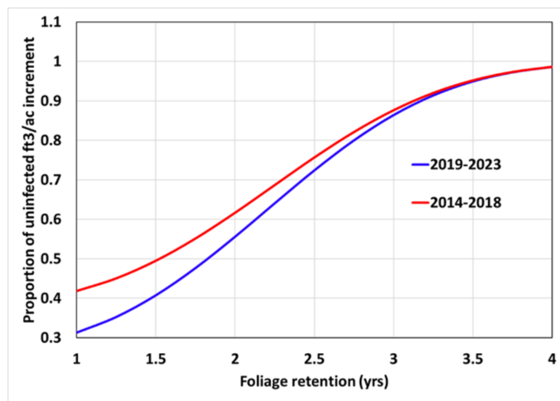


Figure 4 Estimated growth losses from separate period fits to equation [2].

Results and Discussion

The fit to the data resulted in separate estimates of a_5 and a_6 (equation [2]). Expressed graphically, period 2 cubic growth losses for a given foliage retention were estimated to be greater (fig. 3). The absolute loss estimate (1.0 - Y-axis value) should be ignored due to the limited size of the dataset and the over-representation of uninfected plots. A relative comparison of the two periods (full dataset first period growth loss adjusted by relative losses shown in fig. 3) is a more appropriate comparison, and this indicates that growth losses at the lowest foliage retentions estimated at the start of period two were about ~23% greater than that estimated during period one (fig. 4). This greater growth loss

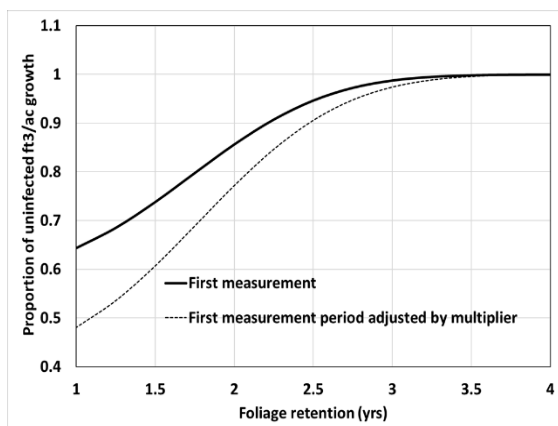


Figure 4 Ratio of the foliage retention effect during period 2 to the foliage retention effect during period 1.

also implies a comparable growth loss in period two as estimated for the GIS plots during the growth periods between 1998 and 2008 (~50%).

Figure 5 indicates that during the five years between 2013 and 2018, the average foliage retention on the group 1 plots increased on the most infected plots, by an average of ~0.3 years. This means that while growth loss estimates during period one were based on the initial value, improvements in foliage retention on infected plots during the period would have presumably improved growth, diminishing the losses for a given initial foliage retention. We will not know the comparable (end of period) foliage retention on these plots until the spring of 2024. Stasis or negative changes in foliage retention during this second period would result in the opposite effect than seen for the first period. A proper analysis of this data will need to account for changes in foliage retention during the five-year periods, with the recognition that some significant changes during the five-year period could go unaccounted for due to the period length.

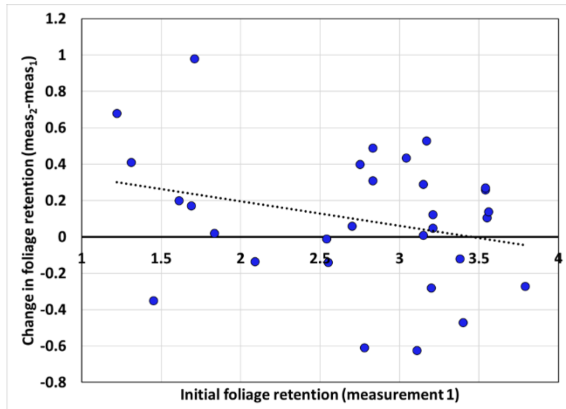


Figure 5 Change in initial foliage retentions between periods two and one for the thirty plots of group one.

Literature Cited

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Ritóková, G., Shaw, D., Maguire, D., Mainwaring, D., Browning, J., Gourley, M., Filip, G., Kanaskie, A., and Marshall, B. 2017. Swiss Needle Cast Cooperative Research and Monitoring Plot Network in Coastal Oregon, Southwestern Washington, and Oregon Cascade Foothills. P. 7-13 in Swiss Needle Cast Cooperative annual report, Shaw, D., and Ritokova, G. (eds.). College of Forestry, Oregon State Univ., Corvallis, OR.