Integrated Pest Management for Swiss Needle Cast in Oregon

David Shaw
Director, Swiss Needle Cast Cooperative
Background

- Swiss Needle Cast is caused by the fungus *Phaeocryptopus gaeumannii*.

- A Native Ascomycete fungus.

- Specific to Douglas-fir.

- Previously unimportant foliage fungus.

- Became abundant and began causing disease in coastal Douglas-fir plantations in the 1990’s.
Stomates (air pores) are clogged causing carbon starvation and disease.

Reproductive structures called pseudothecia (ascospores).

No asexual reproduction.

Fungus does not have internal pathological effect apparently.
Inside the needle, hyphae grow without causing cell death

Photo: Jeff Stone
Phaeocryptopus gaeumannii

Photos Stone/Hansen lab
Photosynthesis

From Manter et al. New Phytol. 2000
Symptoms of disease:

Yellowing foliage (chlorosis)

Especially in spring before bud-break
Early loss of foliage caused by SNC:

Foliage retention impacts tree growth.
Healthy Foliage Retention

Years

1 2 3
Reduced growth, up to 50% or more (mortality rare).

Increases in proportion of latewood.
1996-2007 Aerial Survey
ODF

Oregon Dept Forestry

Sitka spruce – Hemlock Zone

Epidemiology:

Spring/Summer Leaf wetness

Dec, Jan, Feb Temperature

DF plantations

Hansen et al. 2000
Rosso and Hansen 2003
Manter et al. 2005
Integrated Pest Management

• Based on Research of the Swiss Needle Cast Cooperative

• IPM is a common sense approach

• Thresholds are set for action based on knowledge of impacts

• Monitoring of pest distribution, abundance, severity and tree growth impacts form the basis for setting thresholds.

• Prevention/control through silviculture.

• Long-term Planning
Determining Thresholds

- Set by individual landowners

- Site and Landscape Risk Assessment
  - Qualitative estimate of potential impacts
    - Aerial Survey
    - Disease Severity and Needle Retention Models

- Stand Impact Assessment
  - Quantitative estimate of impacts
    - Needle retention estimates from the stand
    - ORGANON growth model adjustment
    - Stand growth assessment tool
Aerial Survey Data published annually on more detailed 1:100,000k maps (yellow is SNC):
http://www.fs.fed.us/r6/nr/fid/as/quad09/index.shtml
Forest Landowners: General Thresholds

• If average needle retention is greater than three (3) then no problem really.

• If average needle retention is less than two (2) problem exists.

• If average needle retention is less than one (1), a real problem that might take intervention.
Needle Retention Map from Greg Latta

Figure 1. SNC Plot Location
Figure 3. Implied relative growth losses for the four GIS growth periods. Ranges of foliage retention represent those measured at the start of each growth period.
Swiss Needle Cast Growth Impact Plots in Oregon. Maguire and Mainwaring.

Established 1998
Balanced with aerial survey to assess real impacts.

Red = Pre-commercial Thinning Study
Green = Growth Impact Study
Table 1. Parameter estimates and asymptotic standard errors for diameter growth modifier ([1]) and height growth modifier ([2]).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter estimate</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter growth modifier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{10}$</td>
<td>1.281594</td>
<td>0.036186</td>
</tr>
<tr>
<td>$\beta_{11}$</td>
<td>0.397308</td>
<td>0.069915</td>
</tr>
<tr>
<td>$\beta_{12}$</td>
<td>2.505400</td>
<td>0.150713</td>
</tr>
<tr>
<td>$\beta_{13}$</td>
<td>0.000230</td>
<td>0.000010</td>
</tr>
<tr>
<td>Height growth modifier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta_{20}$</td>
<td>1.192516</td>
<td>0.017072</td>
</tr>
<tr>
<td>$\beta_{21}$</td>
<td>0.911196</td>
<td>0.067477</td>
</tr>
<tr>
<td>$\beta_{22}$</td>
<td>1.598890</td>
<td>0.164354</td>
</tr>
</tbody>
</table>

Table 2. Summary of percent of healthy diameter and height growth based on equations [1] and [2], respectively at various foliage retention levels.

<table>
<thead>
<tr>
<th>NR</th>
<th>$\Delta$DBH</th>
<th>$\Delta$HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>33%</td>
<td>60%</td>
</tr>
<tr>
<td>1.5</td>
<td>67%</td>
<td>82%</td>
</tr>
<tr>
<td>2.0</td>
<td>90%</td>
<td>94%</td>
</tr>
<tr>
<td>2.5</td>
<td>98%</td>
<td>98%</td>
</tr>
</tbody>
</table>

Figure 1. Observed growth/predicted growth on foliage retention for diameter growth (black line) and height growth (grey line).
Spreadsheet based tool.

Developed by OSU and Oregon Dept. of Forestry.

Stand growth assessment tool if available at the SNCC website:
http://www.cof.orst.edu/coops/sncc/index.htm
Monitoring

- Annual Aerial Survey
- Growth Impact Plots in NW Oregon
- Cascades plots
- New evolving networks

Figure 1. SNC Plot Location
Prevention and Control: Silviculture

Once the potential disease severity and quantitative stand impacts are known.....adaptive silviculture is key.
Typical Foliage Disease Plantation Management Recommendations Are Not Effective in the Zone of the SNC Epidemic.

- Canopy drying techniques don’t work.
- Thinning has no effect, negative or positive.
- Vegetation Management has no effect, negative or positive.
- Pruning not recommended due to foliage removal.
Silviculture: Fungicides

- Fungicides are effective at protecting leaves from fungal colonization. Chlorothalonil based fungicides (Bravo 720, Daconil Weatherstik).

- This only protects current year foliage.

- Spray must occur annually, sometimes twice a year.

- For forestry, this is not economical.
  - Also these fungicides can impact aquatic systems.

http://www.mistsprayers.com/
Silviculture: Fertilization

- Fertilization with N is not recommended.
- Excess nitrogen in leaves may enhance disease.
- Much of the western Oregon Coast Range is already very high in N.
- Other soil amendments have been recommended to ameliorate high N (calcium).
- We are currently anticipating some important research results from Doug Maguire/CIPS Beyond N Study.
- This is an important silvicultural question that remains unanswered.
Silviculture: Mixed Species Management

- Mixed species management may protect against heavy losses.
- Does not ameliorate disease.
- Low Severity (needle retention 2.6 - 3.5 yrs)
  - Local seed sources only
- Moderate Severity (needle retention 1.5 - 2.6 yrs)
  - Douglas-fir < 50% of regeneration planting
- High Severity (needle retention < 1.5 yrs)
  - Douglas-fir < 20% of regeneration planting

Recommendations from Greg Filip et al. 2000
Integrated Pest Management for Swiss Needle Cast in the Epidemic Area

**Long Term**

- Continuous monitoring of growth impacts

- Maintenance of aerial survey, Cascades plots and Growth Impact Plots as a monitoring program

- Tree Improvement collaborations with PNW Tree Improvement Coop
  - Progeny trials on the South Central Coast and North Coast (Trask)

- Continued Research

- Economic and market models
The Swiss Needle Cast Cooperative

http://www.cof.orst.edu/coops/sncc/index.htm

- The Swiss Needle Cast Cooperative (SNCC) was established in January 1997.

- SNCC is located in the Dept. of Forest Engineering, Resources and Management, within the College of Forestry at Oregon State University.

- The focus of the SNCC is Swiss needle cast research for forest land owners in the Pacific Northwest.